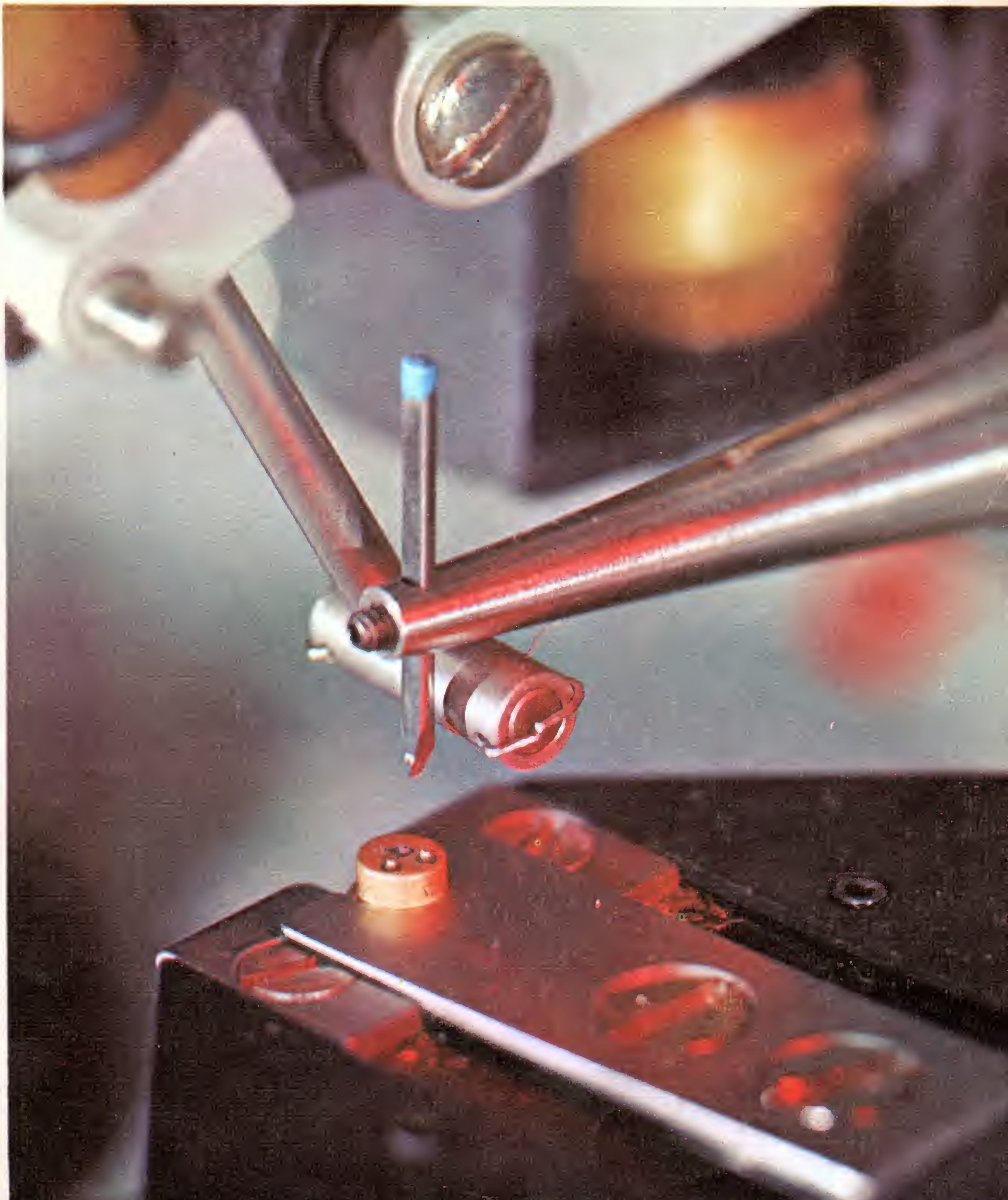
ELECTRONICS Australia

July, 1967

Incorporating RADIO, TELEVISION & HOBBIES Vol. 29 No. 4



30c

3/- N.Z.
35c (3/6) N.G.

ASSEMBLING A SILICON TRANSISTOR

The impact of space research • Intelsat III

60W guitar amplifier • FET voltmeter problems

Printed and published by Sungravure Pty. Limited, of Jones Street, Broadway, at Morley Avenue, Rosebery.

ELECTRONICS Australia

ıcorporating "RADIO, TELEVISION and HOBBIES"

C certified circulation in excess of 47,000.

Volume 29, No. 4

Editor:
NEVILLE WILLIAMS, M.I.R.E.E. (Aust.) (VK2XV).

Assistant Editor:
PHILIP WATSON, A.M.I.R.E.E. (Aust.) (VK2ZPW).

Technical Editor:
JAMIESON ROWE, B.A. (Syd.), B.Sc. (Technology, N.S.W.), A.M.I.R.E.E. (Aust.).

Technical Staff:
IAN POGSON (VK2AZN).
ANTHONY LEO (VK2ZHK).
HARRY TYRER.
JOHN HORSFIELD.
ROBERT FLYNN.
LEO SIMPSON.

Editorial Office,
12th Floor, 235-243 Jones Street, Broadway, Sydney, Australia. Phone 2-0944. Ext. 2531, 2525-6-7.

Postal Address:
Box 2728, G.P.O., Sydney, Australia.

Advertising:
SELWYN SAYERS, Mgr.
BILL SUMMONS, Rep., Sydney. Offices: 8th Floor, 235-243 Jones Street, Broadway, Sydney, Australia. Phone 2-0944, Ext. 2931, 2508, 2943.
CLARRIE LEVY, Rep., Melbourne, 392 Little Collins Street. Phone 67-8131.

Circulation:
A. PARKER, Mgr.
Offices: 9th Floor, 235-243 Jones Street, Broadway, Sydney, Australia. Phone 2-0944, Ext. 2505, 2509.

Subscription Rates—See back page.

Representation:
Melbourne—John Fairfax & Sons Ltd., 392 Little Collins St. Phone 67-8131.
Brisbane—Sungravure Pty. Ltd., 78 Elizabeth Street. Phone 2-6688.
Adelaide — John Fairfax & Sons Ltd., 104 Currie Street. Phone 51-3502.
Perth—Sungravure Pty. Ltd., 847 Hay Street—Phone 23-4513.
Newcastle, N.S.W.—Associated Newspapers Ltd., 22 Bolton Street. Phone 2-3696.
London—John Fairfax & Sons (Aust.) Ltd., Reuter Building, 85 Fleet Street.
New York — "The Sydney Morning Herald" Ltd., "Times Annex," 229 West 43rd Street.

Distribution:
Distributed in N.S.W. by Sungravure Pty. Ltd., Jones St., Broadway, Sydney, N.S.W.; in Victoria by Sungravure Pty. Ltd., 392 Little Collins Street, Melbourne; in South Australia by Sungravure Pty. Ltd., 104 Currie Street, Adelaide; in Western Australia by Western Press; in Queensland by Gordon and Gotch (A'sia) Ltd.; in New Zealand by Truth (N.Z.) Ltd.; in Tasmania by Davies Bros. Ltd., "Mercury," Hobart.

Technical Queries

Quite early in the history of what is now "Electronics Australia" we made provision for a postal query service, mainly with the object of assisting readers who might encounter difficulties with one of our projects. From this small beginning a situation has gradually developed where, faced with an electronic problem, any one of a hundred thousand or more readers are likely to drop twenty cents into an envelope with a request that "Electronics Australia" sort it out for them!

We've struggled for years to cope with the correspondence, trying to give whatever help we could. We've streamlined our procedures to the limit, in an effort to reduce inroads on staff time . . . but to little avail. We have reached the intolerable situation where the handling of postal queries is seriously prejudicing our very ability to produce the magazine itself. We have simply had to draw a firm line, as set out in the panel on page 155. In future:

- We will supply back numbers, tearsheets, reprints, photographs, etc., for the amounts as set out. Where a need can be stated only in general terms, we will do our best to select something from our files which may be helpful.
- As a mark of good faith, we will maintain a postal reply service in relation to articles and projects in the magazine for a period of twelve months after publication.
- We must politely but firmly refuse to answer through the post, questions relating to older projects, to special designs or modifications, or to commercial equipment.
- Questions not eligible for answer by post may be submitted for possible answer through the columns of the magazine. Each month, we will select those which appear to be typical and interesting and publish both question and comment in our "Answers to Correspondents" section.

It is not a pleasant task having to impose limitations on a service which I, personally, have sought to maintain for over twenty-five years. It would be even more unpleasant if I knew that we were offering less than other comparable journals. In fact, this is not the case and, even in its amended form, our reader service compares more than favourably with any other electronics magazine that I know of, from anywhere in the world.

N. Williams

uly, 1967

Silicon Planar Transistors	8
Computer Draws Man in Action	15
Helical Colour TV Recorder	16
The Impact of Space	18
Review—Auto Speed Regulator	23
Review—World Satellite Cover	25
Scientific and Industrial News	29
Design Factors of FET Voltmeter	36
Semiconductors—Gunn Effect	47
Guitar Amplifier 117	48
Serviceman	57
Basic Radio Course—chapter 25	61
Compatible SSB Modulation Tests	71
Forum	73
Playmaster Stereo Amp. 118	77
Reader Built It	89
Know Your Gramophone—part 10	90
Answer Man	97
Audio Topics—Compatible Pickups Not Records	101
Classical Reviews	104
Documentary Records	109
Variety Fare	113
Trade Reviews and Releases	124
Technical Books, Publications	132
Amateur Band News and Notes	137
Listening Around the World	148
Answers to Correspondents	155
Classified Advertisements	159
Classified Advts Form	160
Subscription Form	160
Advertisers Index	160
Errata and Notes	55

COVER PICTURE: Taken at the Fairchild factory in Croydon, Victoria, the picture shows a vital step in the production of silicon Planar transistors. The tiny dice — the actual transistor — now attached to the "header" assembly, is connected by ultra-fine wires to the external connecting leads. (See article on page 8.)

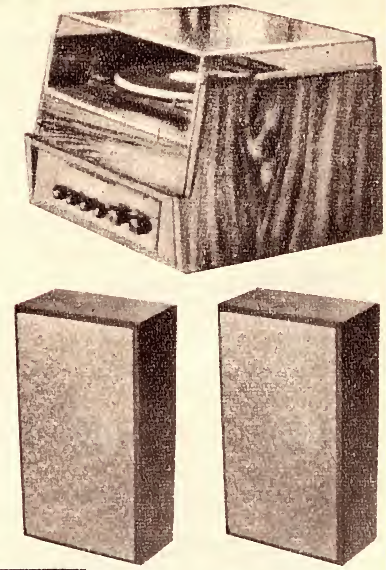
BROADWAY ELECTRONICS

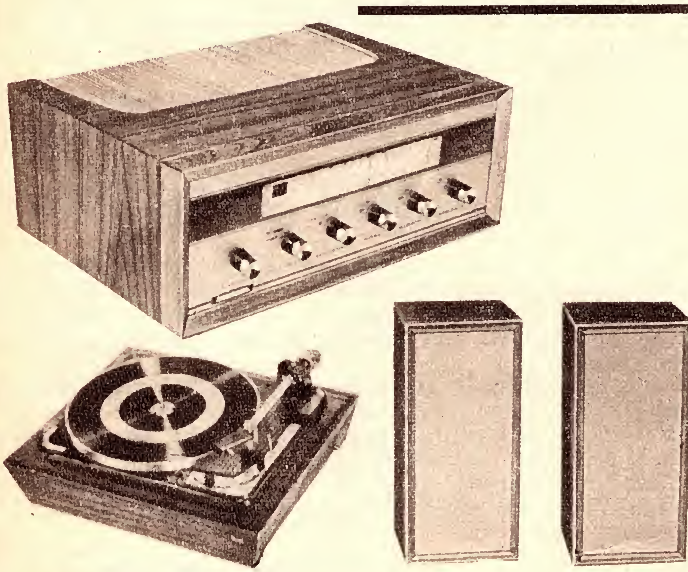
HI-FI outfits...

to suit most homes

Here are two popular combinations from our extensive range

INSTROL-PLAYMASTER No. 106 AMP/TUNER.
DUAL 1010A HI-FI RECORD CHANGER.
INSTROL-PLAYMASTER BOOKSHELF SPEAKERS.
INSTROL No. 50 COMBINATION CABINET.
COMPLETE PRICE **$282.90.**





INSTROL AT1 AMPLIFIER/ TUNER.

DUAL 1009SK RECORD CHANGER.

SHURE or ADC Magnetic cartridge.

WHARFEDALE SUPER 8RS/ DD SPEAKERS.

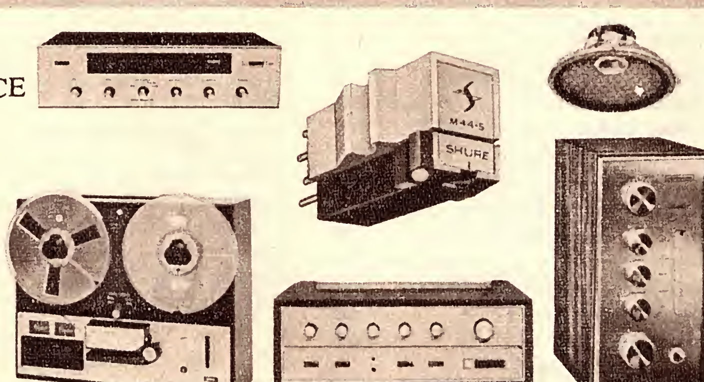
(All units fitted to MODULE CABINETS)

Including perspex cover

COMPLETE PRICE **$400.00**

Yes, we carry a range of imported loudspeakers, players, amplifiers and tape recorders. Please state your requirements and we will gladly quote. All well-known brands stocked.

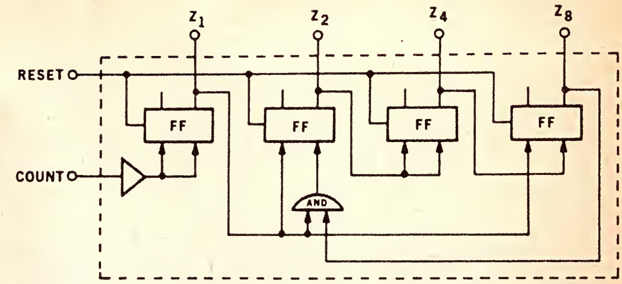
INSTROL	LABCRAFT
PLAYMASTER	ALL BALANCE
FISHER	DUAL
ROLAND	ELAC
TRIO	GARRARD
SANSUI	SONY
WHARFEDALE	BRENELL
GOODMANS	MINICONICS
SHURE	AKAI
ADC	TEMPO
DECCA	LEAK
	QUAD




Please help us
rescue Joe.
FAIRCHILD

CμL 9958 DECADE COUNTER

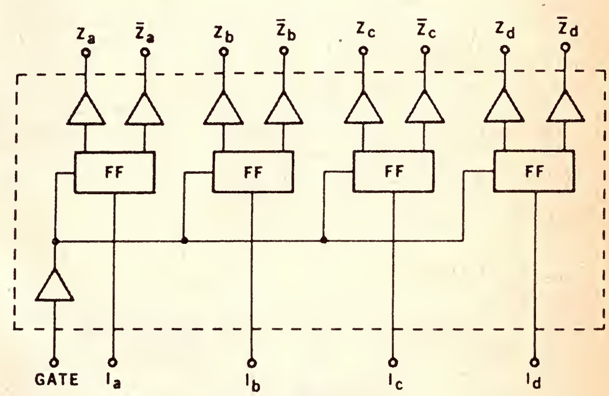
our flip-flops, a count input amplifier and a reset nput are interconnected internally, so 9958 counts rom 0 to 9 inclusive in 1-2-4-8 binary coded decimals (BCD). Four outputs are labelled Z_1, Z_2, Z_4 ınd Z_8. A high level pulse resets the circuit to count 0. It remains at this state until low level voltıge starts it counting. 9958 can be preset to any ırbitrary number by pulling down the appropriate $_1$; 2_2; 2_3; 2_4 pins. Maximum input is 2MC uaranteed, 4MC typical. Count inputs are to 2.0 MHz. V_{cc} range is 3.3V to 5.5V. Operating emperatures range from 0-75°C. Packages are 4 pin Dual-In-Line. Loading rules are given in our ree 9958 data sheets. The 9960 data sheet and APP118/2 show applications typical of counters, VM's and test equipment. Another use is as a 0:1 frequency divider.



IEW 'RICES:	1-24 **\$11.20;** 25-99 **\$9.00;** 100-999 (SINGLE) **\$7.50;** 100-999 (MIXED) **\$7.85.**

CμL 9959 4-BIT BUFFER-STORAGE ELEMENT

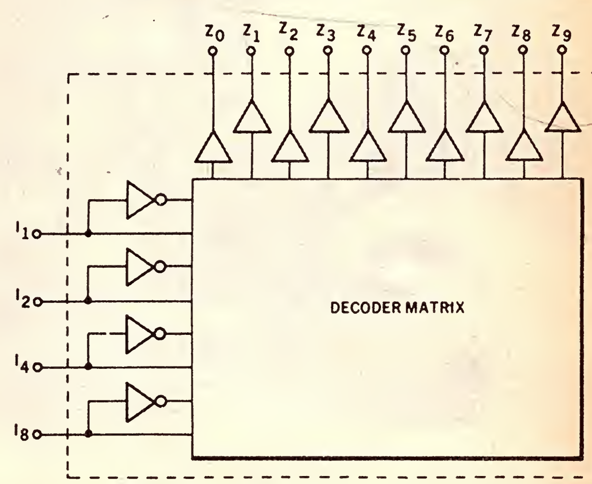
9959 is a static storage register or a memory levice. Information from 9958 is sampled and held n 9959 until new information is entered. So it is a nemory circuit consisting of four latch circuits and common gate driver. When the gate input is high, ıo information enters and 9959 remains static. When the gate input is low, new information is ntered into each latch and transferred to the outout. At a greater count frequency than 10 CPS, he 9959 must be used to display the sampled count. t is not required at lower than 10 CPS, or when ›nly the final count need be displayed. Operating emperatures are 0 to 75°C, extendable to 55 to 25°C. V_{cc} range is 3.3V to 5.5V. Package is 16 pin Dual-In-Line. 9959 can also be used in conunction with RTμL elements. Loading rules are given on the 9959 data sheet — free from Fairchild.



IEW 'RICES:	1-24 **\$10.05;** 25-99 **\$8.00;** 100-999 (SINGLE) **\$6.75;** 100-999 (MIXED) **\$7.05.**

CμL 9960 DECODER DISPLAY DRIVER

Compatible with 9958 and 9959, 9960 is a monolithic levice which decodes BCD into decimal numbers ınd drives the appropriate cathodes of a gas filled ead-out tube (or Nixie). It accepts only 4-line 1-2-4-8 BCD information from binary 0 to binary 9 nclusive. Higher Count (10-15) input causes two outputs to turn on simultaneously. 9960 works at specific voltages, with logic levels also supplied oy RTμL devices. To withstand the high voltages of the read-out tube, the 9960 breakdown voltage s 55V min and typically 75V. The 'on' output can ›ass up 10mA, adequate for even a 'Jumbo' size ube. 9960 is not recommended for use by itself ıs a decoder. Operating temperatures range from)-75°C, extendable to −55°C. V_{cc} range is 3.3V to 5.5V. Package is 16 pin Dual-In-Line. Loading rules ıre given on the free 9960 data sheet.



IEW 'RICES:	1-24 **\$15.70;** 25-99 **\$12.55;** 100-999 (SINGLE) **\$10.50;** 100-999 (MIXED) **\$11.00.**

FAIRCHILD AUSTRALIA PTY. LTD.

From raw materials to the finished product:

SILICON PLANAR

Fabrication of transistors using the Planar (T.M.) process involves two basic concepts: (1) gaseous diffusion of impurity atoms into the host semiconductor wafer, and (2) the use of a silicon dioxide layer on the surface of the wafer, which by its virtual "capacity" to the impurity atoms functions both as a protective sheath for the wafer and also —when appropriately etched away using a photolithographic technique — as a selective mask to control the diffusion.

Two types of transistors are produced using the Planar process — those in which the basic wafer prior to the diffusion processes consists of a host semiconductor substrate to which has already been epitaxially grown a suitably doped collector layer, called for convenience "epitaxial devices," and those in which the basic wafer consists only of homogenous host semiconductor. The latter are called "non-epitaxial devices."

Non-epitaxial wafers are produced from single crystal ingots grown pre-doped as either "N" or "P." The ingots grown for these wafers are lightly doped: in other words. they are of high resistivity because the breakdown behaviour of the resulting transistor is determined by this starting resistivity. Resistivity ranges are from 0.5 ohm-cM to 50 ohm-cM, depending on the device being made. The ingots are grown from molten silicon at approximately 1500 deg. C.

To maintain substantially uniform doping throughout the crystal and thus get more usable wafers for a given product, a dopant must be chosen that has very close to the same solubility in molten and crystalline silicon, so that the dopant will distribute itself evenly. "N" ingots are doped

With the aid of a binocular microscope, an operator attaches the tiny wires which connect the emitter and base of the dice to the external connecting leads. These are part of the "header" assembly, to which the dice is attached.

with phosphorus, while "P" ingots are doped with boron After the ingot has been grown, it is sliced with a diamon saw into wafers approximately 14 mils. thick (.014 inches o 350 microns). Wafers from the correct resistivity range ar selected, then lapped, etched and polished so that th surface is mirror-like. The wafer at this point is approxi mately 8 mils thick, and of a diameter such that it wil ultimately be capable of division into a great many individua transistor dice.

Epitaxial wafers are produced in a similar manne The ingots grown are very heavily doped to obtain ver low resistivity substrates. Typical resistivity for an epitaxia substrate is .005 ohm-cM. The substrate is then sawn, lapped polished and etched to wafers approximately 5.5 mils thick Next a high resistivity epitaxial film is grown on the to of these substrate wafers. This process takes place in a epitaxial reactor at approximately 1200°C. Depending upo device design, this film can be very thin — 4 micron (.2 mil) or relatively thick — 18 microns (.75 mil). Th film is grown in such a way that the atoms continue th single crystal structure of the wafer — hence the tern "epitaxial."

The reason for the epitaxial process is twofold. First and most important, epitaxial devices have lower Vce (sat (collector-emitter saturation voltage) and larger useful cur rent ranges while maintaining high breakdown voltages Secondly, because double-diffused devices contain most o the effective stored charge in the high resistivity collecto regions, reduction of the physical volume of the high voltag collector region lowers storage time and thus improve switching times.

Figures 1 and 2 depict cross-sections of non-epitaxia and epitaxial wafers.

The next steps in the process involve multiple selectiv diffusions. In order to do these diffusions while still protect ing the device, silicon dioxide (glass) is grown on the surfac of each wafer. Then, using a photolithographic process windows are cut through this oxide through which ar diffused the "N" and "P" dopants. This step — oxidatio prior to any diffusion — is the key to the Planar process This process will only work if the dopants used will no diffuse through the silicon dioxide coating. Thus, the dopant must be chosen carefully. The reason that silicon Plana transistors are possible is that there are dopants which wil not go through silicon dioxide.

It is possible to oxidize germanium and thus make Planar germanium structure. However, the diffusants use go right through the germanium oxide as well as an windowcut, so that germanium oxide Planar transistors ar not practicable.

The window cutting process is shown in figures 3 to 8 The steps are as follows:

(1) Wafer is oxidized — figure 3.

(2) A photosensitive material is applied to the top o the wafer. This material is called photo resist — figure 4.

(3) a light pattern is projected on to the wafer to expos certain areas, leaving unexposed areas or "windows" —figure 5.

(4) The wafer is dipped in a developer which onl removes the unexposed photo-resist — figure 6

(5) The wafer is dipped in an etchant, primarily hydro fluoric acid which attacks only the now expose silicon dioxide. It affects neither the exposed photo resist nor the silicon—figure 7.

(6) The wafer is then dipped into a solution (chromi acid) which washes away the remaining unexpose photo-resist leaving a window in the silicon dioxid through which dopants may pass — figure 8.

TRANSISTORS

By D. D. Myles,
Fairchild Australia Pty. Ltd.

Each time a window is cut this same process is used. ote: The wafer has silicon dioxide on both sides after ch diffusion step. All the diffusions are done from one le. The back side is etched off in step 5 above.

In making Planar devices, each time a wafer comes out a furnace the entire wafer has silicon dioxide covering junctions. Towards the end of each diffusion step oxide grown over the diffusion windows. Thus the junctions e protected during each step. Figures 9 to 12 show the ultiple diffusion-oxidation cycle involved for a double-fused device. Nete: (1) that the multiple oxidations leave eps in the oxide. Oxide grows everwhere when it grows at , including the reverse side of the wafer. These steps n clearly be recognised under a microscope as apparently fferent colours, due to the refraction of light through the fferent thicknesses.

The first diffusion in Fairchild's process is the base ffusion. After base diffusion, the emitter diffusion is accomished. To provide the correct polarities, doping densities d process control, different doping agents are used for e different regions. For the base of an NPN and the iitter of a PNP boron is used as the doping agent. For e base of a PNP and the emitter of an NPN phosphorus used.

At this point in the process most of the characteristics the transistor will be determined. The factors which fect these characteristics are important and should be entioned.

First, some preliminary information is necessary:

(a) The process of diffusion is a dynamic one. When a wafer is exposed to diffusion temperatures (approx. 1000 deg. C) the doping agents will all diffuse from areas of high concentration (highly doped) toward areas of low concentration (lightly doped). Hence during the emitter diffusion, for example, the base-collector junctions will tend to "travel" further into the wafer.

(b) The speed at which a dopant moves is directly related to both concentration and temperature. The higher the temperature or concentration, the faster the dopants will move.

(c) Because there is only a fixed amount of dopant on a wafer or transistor, the farther away from the surface of the device the junction goes (deeper), the lower the concentration of dopant.

(d) A region of high dopant concentration has low resistance or resistivity. Low resistivity comes from the fact that large dopant concentrations lead to large concentrations of carriers (electrons or holes).

After the base is diffused the emitter-base junction ust tend to "catch up" with the collector-base junction provide a thin base, as shown in figure 13. The characistics of the transistor can be greatly influenced by the cation within the transistor of the base region.

Figure 14 shows a finished transistor die with the portant dimensions labelled:

E = depth of the emitter.

B = depth of the base.

T = thickness of the base.

"T" is not independent of either "E" or "B." Because practical considerations it is much easier to make "T" nall (thin bases) when "B" is small (shallow base). In ldition one has much better control of both "B" and "E" nitter and base depth when the doping densities are latively large. A rule of thumb for best control is that ie emitter depth should be ¾ base depth.

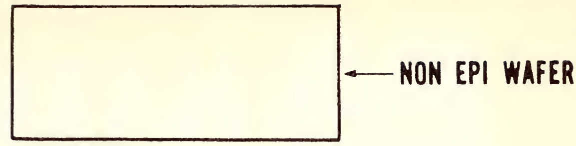


Fig. 1

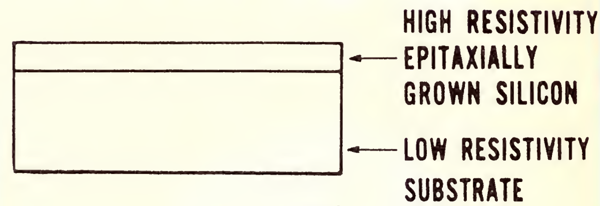


Fig. 2

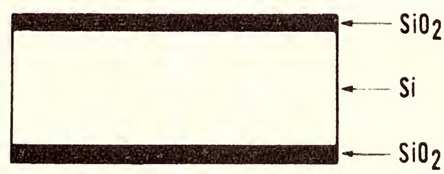


Fig. 3

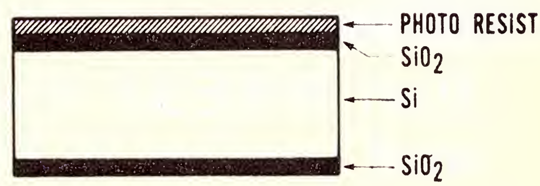


Fig. 4

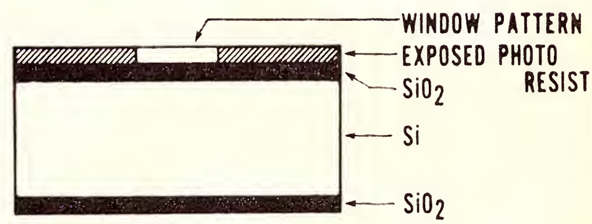


Fig. 5

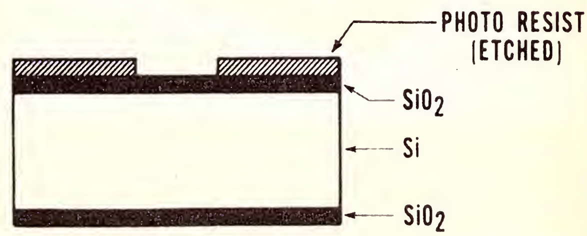


Fig. 6

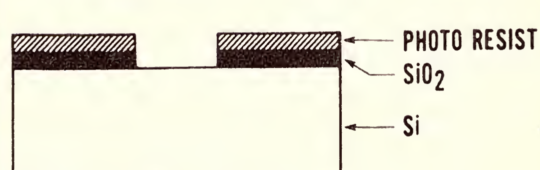
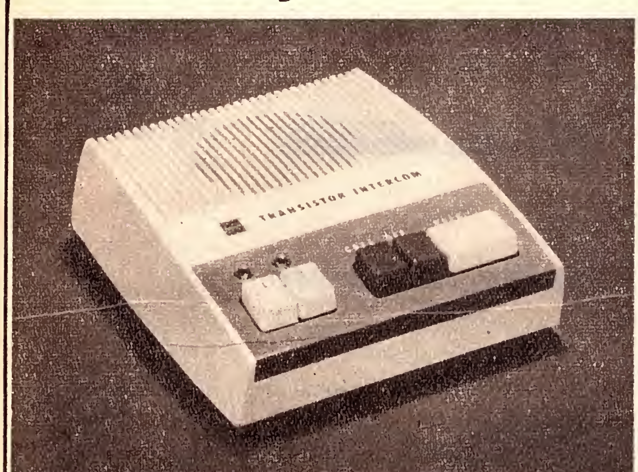
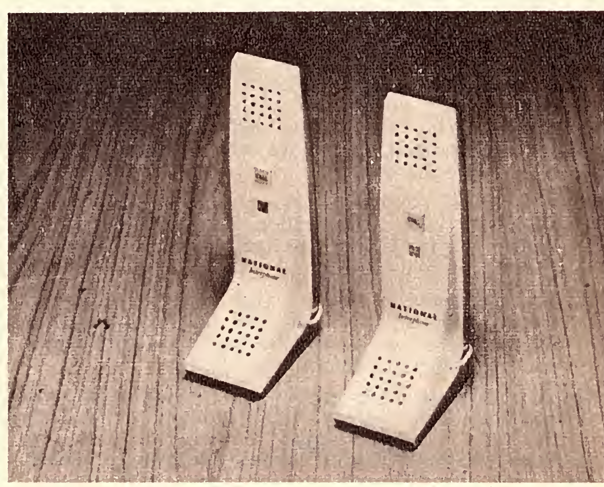


Fig. 7

NATIONAL INTERCOM

Just PRESS the BUTTON, MAN and you're in business at home!





There's a National Transistorised Intercom for every home use. Inexpensive, professional, battery-operated units for all possible installations.

DOORPHONE is the handiest device for any home. Model VL125 surface mounting and VL126 flush mounting with built-in two-tone chimes lets you speak to callers without going near the door. **$45.00.**

UNIQUE STANDPHONES twin-matching ultra modern design. Exceptionally clear conversation. Free talking system. Model VL290—**$23.70** pair.

2, 3 OR 4 STATION. Simple masterselective fully transistorised units for either communication . . . connect rumpus room, garage, kitchen, bedroom, dining room, sunroom, etc. Models VN131 (1 master, 1 remote)—**$27.00**, VN132 (1 master, 2 remotes)—**$39.50**, VN133 (1 master, 3 remotes)—**$49.50.**

BUSINESS INTERCOM: A complete range (up to 100 station is available)—write for leaflet.

FREE Inter-home CIRCUIT

All NATIONAL Home Intercoms are available from electronic wholesalers. Fill in the coupon below for name of nearest wholesaler and if you require a free circuit to show how all Inter-home communication systems can be inter-connected, WRITE

To HACO DISTRIBUTING AGENCIES PTY. LIMITED,
57/69 Anzac Parade, Kensington, N.S.W.

HACO

Your Name..............................

Your Address..............................

....

INTERCOM S709

In addition to the emitter and base diffusions other iffusion steps are needed to provide the special charac- ɜristics of today's high performance devices.

PNP transistors pose a problem due to the tendency f the surface near the oxide in the collector region to invert"; that is, to change from "P" material to "N" ıaterial. An inversion layer of this type is called a channel. 'wo methods are used at Fairchild to eliminate this problem. 'he first involves a gallium diffusion across the whole urface of the chip. This process lowers the surface resistivity ɔ that inversion will not occur. This process is limited ɔ low voltage devices due to the fact that the actual reakdown voltage of the device is lowered.

The second method is used on higher voltage devices. : involves a modification of the so-called "annular ring" rocess, illustrated in figure 15. At the same time as the mitter is diffused, a diffusion is made outside and around ıe base area, extending all the way to the edge of the hip. In addition, a so-called EQR (equipotential ring) shield ontact is deposited during the metalising step, extending ·om this low resistivity surface diffusion over the silicon ioxide above the collector-base junction. These added steps ave the following results:

(a) The low resistivity surface diffusion terminates incipient inversion layers (channels). An annular ring not extending to the edge of the chip might not do this, as it could have crystalline defects which allow a channel to continue on to the other side.

(b) The EQR changes the electric field in the oxide from horizontal to predominantly vertical. A horizontal field (called a transverse field) can move ions horizontally through the transistor structure to make an incipient channel grow. The EQR minimises this effect. When the EQR is used, the gallium diffusion is not used.

Thus, with the surface diffusion terminating the channel, :QR limiting ion movement, and the PLANAR II process liminating the ions, virtually every safeguard possible is rovided to ensure a reliable device.

Devices intended for high speed saturated switching ɜceive a further diffusion to reduce the lifetime of the arriers. Gold is diffused into the device from the **reverse** ide of the wafer. Reducing the lifetime lowers the storage me of the transistor. Storage time can be reduced by factor of approximately 50 times using this method. In non-gold doped transistor the storage time is about 85 er cent of the total switching time. Gold doping thus ɜduces total switching times from approximately 1uS to ıe low nanosecond region. Some undesirable side effects re introduced but, when saturated switching is the criteria, ıese side effects are less important. The side effects are:

(a) Leakage (currents) are increased.

(b) Vce (sat) increases.

(c) hfe (the DC forward-emitter current gain) is reduced.

Devices requiring high hfe and low leakage must get ıe opposite treatment from gold doping. Material must e diffused into the device which increases the lifetime. 'hus, a "gettering" is performed on these devices to raise fetime by lowering the recombination centres. This gettering ; done like gold diffusion from the reverse side. Suitable ettering agents are nickel and phosphorus.

Both the gold doping and gettering steps are performed fter the last diffusion (emitter diffusion, or gallium).

Once the transistor wafer is completely diffused, metal ontacts must be made to the active base and emitter ɜgions. Figure 16 illustrates the sequence for depositing luminium for this purpose.

Figure 16A shows a transistor with the oxide cuts or both the emitter and base metallising. The reverse-side ilicon dioxide has already been etched away during the tep that cuts the windows for the metallising. The wafers re placed in a bell jar which contains aluminium pellets. 'he jar is evacuated and the aluminium vaporised, deposit- ıg it on the complete surface of each wafer.

Figure 16B shows the device after the aluminium is eposited. Then, using similar masking and etching steps ɔ those described above, the aluminium is removed from he surface of the wafer except in the places required for ase and emitter contacts, any metal-over-oxide bonding ıads, or EQR rings.

Figure 16C depicts a wafer at this step. The wafers re then put in a furnace at approximately 600°C in rder to allow the aluminium into the surface. This

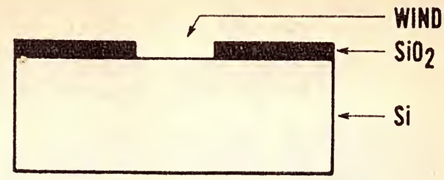


Fig. 8

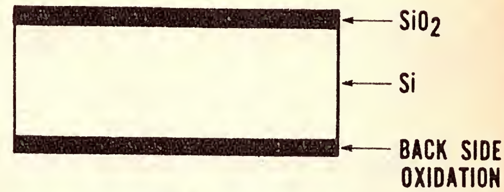


Fig. 9

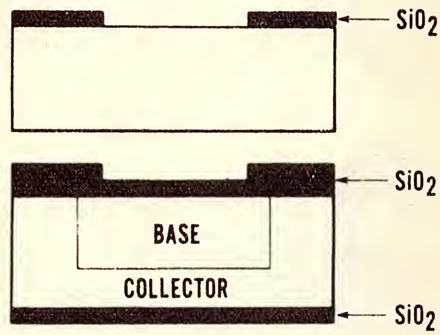


Fig. 10

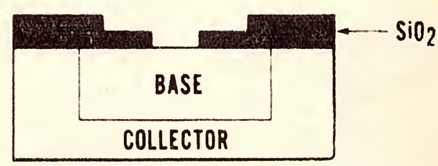


Fig. 11

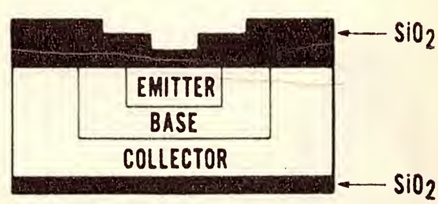


Fig. 12

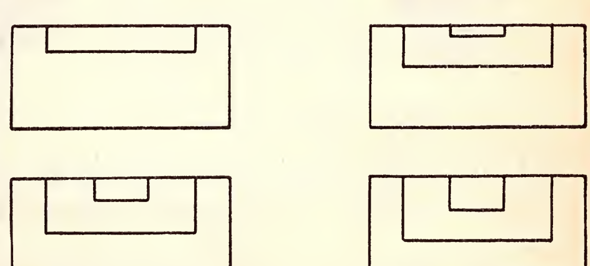


Fig. 13

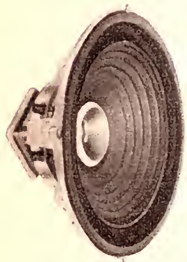
FOR GREATER CLARITY AND NATURAL MUSICAL REPRODUCTION OVER THE COMPLETE SOUND SPECTRUM INSIST ON

WHARFEDALE LOUDSPEAKERS

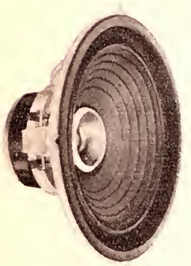
The finest sound reproducers in every class proudly carry the WHARFEDALE name . . . for design is advanced and WHARFEDALE sound is audibly superior. WHARFEDALE's exclusive roll surround permits extended cone excursions in small and airtight enclosures to provide effective bass response; high frequencies retain linearity due to WHARFEDALE's unique double diaphragm. Transient performance of WHARFEDALE loudspeakers is outstanding — clarity and attack are particularly obvious in wide range WHARFEDALE units. **Ask for a free catalogue providing detailed specifications on the WHARFEDALE range when you visit your favourite audio store.**

PST/4
A low cost tweeter for budget multiple speaker systems. Frequency response is 300-15,000 Hz., impedance 10/15 ohms. The perfect partner for the Bronze 8 RS/DD or Bronze 10 RS/DD.

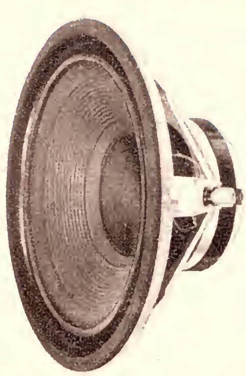
8" BRONZE/RS/DD
Very effective in a 1 cu. ft. enclosure, the response of this low priced model is 50-20,000 Hz. Impedance 10/15 ohms. Handles 10 watts peak power.



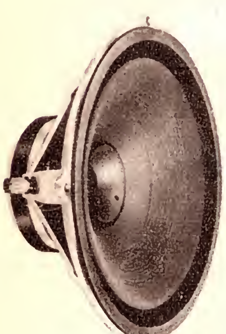
10" BRONZE/RS/DD
A low priced wide range speaker with a frequency response of 35-20,000 Hz. and ideal for use in a small enclosure. Rated at 12 watts peak power. Roll surround and double diaphragm.



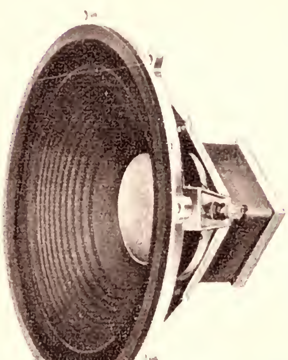
GOLDEN 10/RS/DD
Frequency response is 30-20,000 Hz. and performance particularly satisfying even in small enclosures. Impedance 10/15 ohms. Handles 16 watts peak power.



W 12/FRS
Handling 30 watts peak power, the W 12/FRS is an ideal bass reproducer for multiple speaker systems. Frequency response is 30-4,000 Hz. and a "Flexiprene" surround permits long cone excursions. Impedance: 15 ohms.



RS/12/DD
A wide range 12" loudspeaker designed to provide high fidelity in an enclosure as small as 2 cu. ft. Frequency response is 25-17,000 Hz. and power handling capacity is 30 watts peak. Impedance 12/15 ohms.

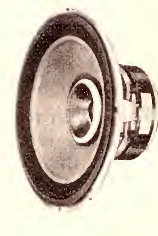


W 15/RS
This 15" woofer handles 40 watts peak power and frequency response is 25-1,500 Hz. Used with the Super 8 and a Super 3 (Crossover HS/400/3), a superlative three speaker system becomes available. Impedance of the W 15/RS is 12/15 ohms. Weight 13½ lbs.

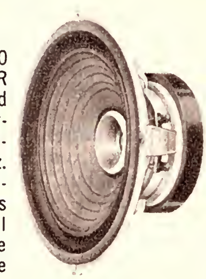
SUPER 3
An excellent tweeter with a frequency response of 1000-20,000 Hz. Aluminium voice coil, impedances 2/3 ohms or 10/15 ohms. Pole size 1", weight 3½ lbs.

SUPER 5
Frequency response 400-17,000 Hz., impedance 10/15 ohms, pole size 1" diameter. Aluminium voice coil. Excellent for addition of presence in the middle register and a top quality H.F. reproducer.

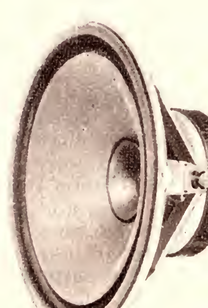
WHARFEDALE



SUPER 8 RS/DD
With roll surround and double diaphragm, this high quality 8" wide range speaker features an aluminium voice coil. Frequency response: 30-20,000 Hz. Ideal for small enclosures; rated at 12 watts peak power. Impedance 10/15 ohms.



SUPER 10 RS/DD
A flux density of 16,000 oersteds gives the SUPER 10 higher sensitivity and outstanding transient performance; frequency response is 30-20,000 Hz. Used in a 2 cu. ft. enclosure excellent results are obtainable. Roll surround and double diaphragm. Impedance 10/15 ohms.



SUPER 12/RS/DD
The ultimate in domestic high fidelity loudspeakers. Frequency response is 25-20,000 Hz., and the SUPER 12 is rated at 40 watts peak output. Flux density is 17,000 oersteds. Pole size: 1¾". Impedance is 12/15 ohms.

IT'S WHARFEDALE QUALITY THAT COUNTS!

Australian National Distributors:

Simon Gray Pty. Ltd.

Head Office: 28 Elizabeth Street, Melbourne, Vic. Tel. 63 8101*

Sydney Office: 22 Ridge Street, North Sydney, N.S.W. Tel. 92 3890

INTERSTATE REPRESENTATIVES:

S.A.: Eilco Sales Pty. Ltd., 7-9 Osmond Terrace, Norwood, S.A. Tel. 63 4844
Q'land: Sydney G. Hughes. 154-158 Arthur St., New Farm, Brisbane. Tel. 58 1014
W.A.: Athol M. Hill. 613-615 Wellington Street. Perth. Tel. 21 7861
Tas.: K. W. McCulloch Pty. Ltd., 109 York Street. Launceston. Tel. 2 5322
A.C.T.: Australian Physical Laboratories. P.O. Box 225. Canberra City. Tel. 4 3010 (Mr. J. E. Howe)
N.T.: Pfitzner's Music House. Smith Street. Darwin. Tel. 3801

lloying process provides good adhesion and electrical con-ıct between the aluminium and the surface. Without the lloy step the aluminium would readily peel off and lead ›ond pads would easily lift from the transistor surface. ıfter alloying, the wafers are lapped to final size from ıe reverse side. At this point in the process, devices which /ill use the no-preform die attach have the gold backing pplied.

Once the wafer has thus been metallised, it is ready ɔ be die sorted, cut up, and mounted. The die sorting is erformed with the wafer held rigid on a vacuum chuck. :ach potential device is electrically probed, an ink dot ıarking the bad devices. Once die sorted, the wafer is ıounted on a plate face up, again held tightly by a vacuum huck. The wafers are scribed with a diamond point, and re then broken into dice.

The process of mounting the individual dice on to ıeir "headers" is as follows:

(1) The header assembly is brought up to temperature approximately 400°C.
(2) The chip is placed in contact with the header. If reverse side gold is not used, a gold solder pellet or "preform" is placed on the header under the chip. The reverse-side gold applied to some devices eliminates the need for a solder preform.
(3) The solder preform or the reverse-side gold forms a eutectic bond between the chip and the header.

The next step is to attach leads to the mounted die, sing one of two main procedures. If thermocompression all bonding is used:

(1) The header carrying the die is raised to a temperature slightly below the gold solder melting point —350°C.
(2) A gold bond is made to the "capillary" lead.
(3) The gold capillary wire is resistance welded to the terminal lead "post" by another operator. The device is at room temperature during the welding operation.

If aluminium ultrasonic bonding is used, an aluminium ′ire is ultrasonically bonded at the same work station oth to the die and to the terminal post. No heat is ıvolved in an ultrasonic bond.

From here the devices are cleaned, baked, sealed, ɜsted and shipped.

By far the most common method used for 100 per ent testing of transistors today is DC multi-parameter ɔw-duty cycle testing, using a short duration pulse (typically around 400 micro-seconds). This is to ensure that ıe device is not overheated or destroyed when measuring arameters. Equally important, no appreciable change in ıarameters occurs due to heating of the junctions at the onditions specified. This possible change in parameters must e considered when comparing results of tests obtained y methods using long duty cycle or steady-state conditions.

Single parameter testing is occasionally required for pecial types or for specific customer requirements. These ıay be DC or dynamic tests and usually take about the ıme time per unit as a multi-parameter tester, which can erform perhaps 20 tests in one second. Obviously for conomic reasons, variations to the basic specifications hould be avoided wherever possible.

Dynamic tests in particular usually take longer, as ıost equipment designed for this purpose requires time ɔ stabilise (particularly noise figure testers). In fact, epeatability of test results on a multi-parameter basis is xtremely difficult and leaves some doubt as to their ultiıate reliability. In general, Fairchild guarantees almost all ynamic parameters by the intrinsic properties of the device Geometry-dopant level, etc.) and the successful passing of he DC tests on a 100 per cent basis.

Additional tests of a peculiar nature could have a ramatic effect on yield, involving more expense to the ustomer. As more devices have to be tested, more time ; correspondingly taken, and the discard units may not hen be easily disposed of—if at all.

Maximum and minimum gain devices are sometimes equired and are difficult and time-consuming to find because ›f the processes in producing a given transistor for a given pplication. For example, when a certain application is ›etermined, a transistor is designed so that maximum yield or the device will be centred around the desired characeristics. The wafers so produced are electrically sorted into lasses to suit the published specifications written around

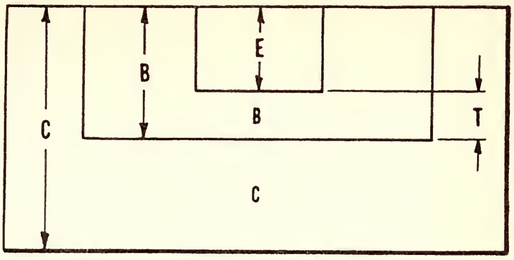


Fig. 14

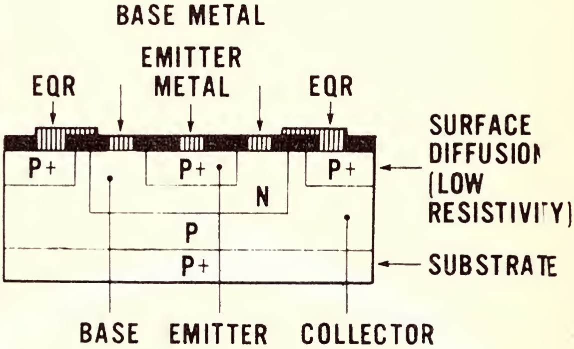


Fig. 15

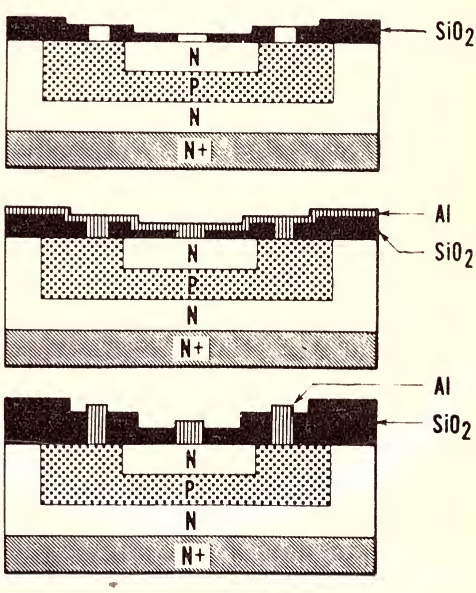
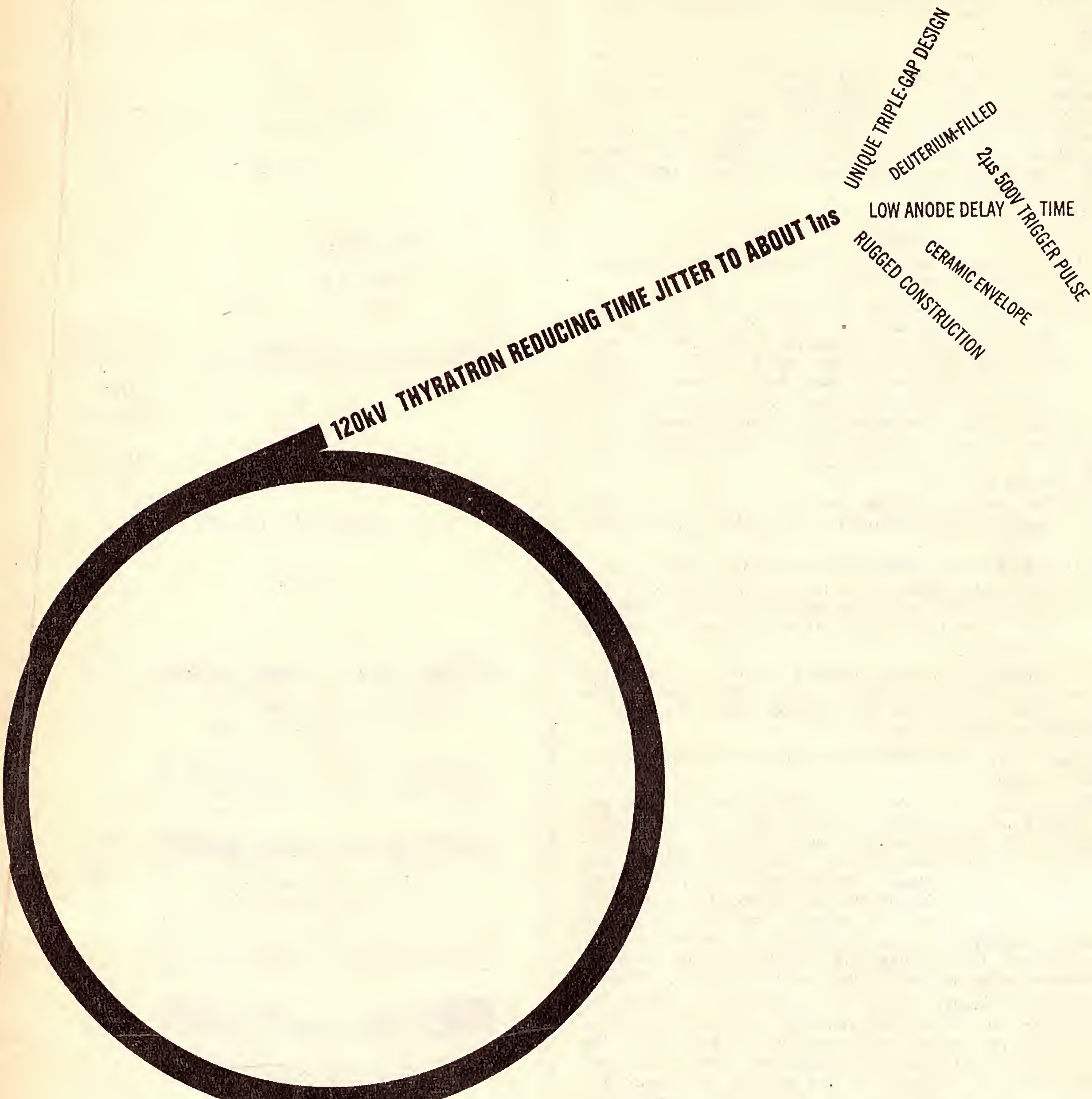


Fig. 16

the device. When certain types are required, the specific class of dice is chosen to ensure production of finished devices with maximum yield to the type required. This means that devices on the fringes are comparatively rare and thus hard to find.

Test equipment, such as the Tektronix Curve Tracer, is extremely useful for tests of this nature and also for correlation to specification conditions or evaluation of transistors to other than specification conditions. Providing the points mentioned earlier about dissipation are observed, correlation to pulse test conditions is not difficult to make.

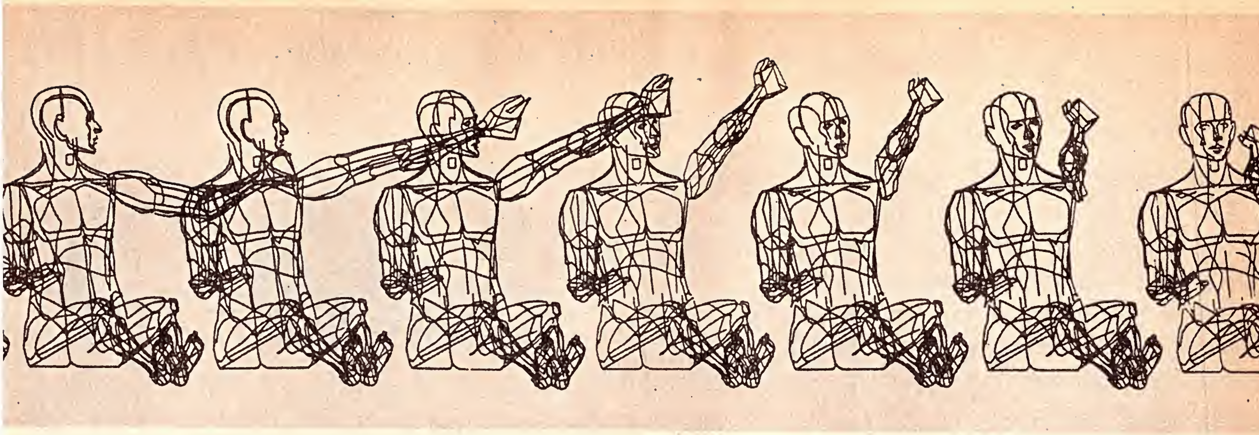
In conclusion, it should perhaps be noted that all the testing in the world does not make a device more reliable. Reliability must be inherent in the process and design, and this is the aim of the Fairchild Planar process.



Precision Control for Nuclear Accelerators

The new English Electric 120kV triple-gap thyratron, CX1171, is unique. With it, nuclear accelerators can be controlled more precisely, more predictably, than with any other device. The greater precision of accelerator operation that results is due to three important features of the tube: extremely low time jitter of about 1ns, low anode delay time and triggering with a 2µs, 500V pulse. The CX1171 can be used at high repetition rates. Two tubes in parallel will allow switching of even higher powers and longer pulses. Of rugged ceramic construction, the CX1171 is deuterium filled and incorporates a reservoir operated from a separate heater supply. For further details please get in touch with:

AMALGAMATED WIRELESS VALVE COMPANY PTY. LTD.
SYDNEY • MELBOURNE • BRISBANE • ADELAIDE • PERTH
DISTRIBUTORS FOR ENGLISH ELECTRIC VALVE COMPANY LTD.



This is how a computer draws

MAN IN ACTION

The row of sketches above were drawn by a computer to illustrate the movements of airline pilots carrying out routine duties in flight. The principle would appear to show promise in all fields of time and motion study.

By Wes Robinson

Computers have been serving people bediently for years, solving their prob-:ms, setting up their schedules, making heir reports, even keeping track of their ank accounts. Now, a Boeing com-uter has been given one of the most xtraordinary human assignments of all – drawing animated sketches of man in ction.

Design engineers who put together air-raft cockpits and controls must know ow a pilot will react physically to a articular arrangement of dials and in-:ruments. Are emergency controls too ard to reach? Are certain instruments in ie wrong place? Can movement in the ockpit be reduced by rearranging seats r controls?

Manufacturing a full-scale model or iockup of every contemplated cockpit esign to get these answers is expensive. Iaving a pilot run through simulated istrument checkout in each mock-p would be time-consuming. So, be-ore investing time and effort in this 'ay, Boeing designers decided to let a omputer figure out whether a certain-:zed pilot could operate comfortably in ie cockpit of a particular design. The omputer would show pilot "reach" dis-inces and movements with mathema-cal precision.

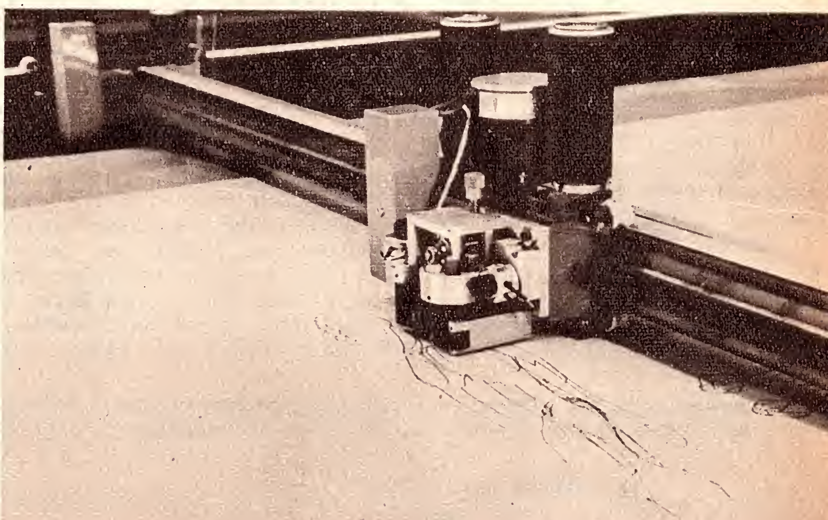
Drawing the human figure in action i the cockpit was the next logical ex-:nsion of these computer experiments. 'oeing's computer graphics organisation iok the anthromorphic dimensions of median pilot from Air Force data. If ou lined up all the pilots by height, :om tall to short, and again by weight, ien by hat size and then by length f arm, the man in the middle or each ne would, in order, stand 5 feet, 9 inch ill, weigh 162 pounds, wear a size -1/8 hat and have a 34-inch reach. This :presentative pilot was drawn in seven segments — the body below the waist, the torso, the head, the two upper arms and the two lower arms. Each segment was prepared for the computer with the same dimensional preciseness used in manufacturing parts for commercial jets. The result is a human figure that bends and twists with unusual realism, despite the fact that it is composed of only seven segments.

"We could spend more time animating the figure, of course," said Bill Fetter, computer graphics supervisor. "With 20 or 40 movable segments, we could probably bend the little finger of an animated figure. However, our purpose here is to find out as much as we can with the aggregates of movement available to us from a seven-unit figure."

The computer draws each part of the body as an individual unit. A graphics designer dictates where each section of the body will join the other, thus determining to a large extent the figure's action.

Fetter predicted it will soon become possible to store complete combinations of movement in a computer memory and call them out as total "subsets" with only one command, such as "run," "walk" or "bend." The computer would respond by drawing the appropriate combination of bodily segments in the requested pose.

A cockpit to suit the tallest or the shortest pilot can be designed from the computer studies, as well as more comfortable aircraft seats, better leg rests and more convenient kitchen galleys. Spacecraft designers find the computer sketches equally useful in determining instrument placement and cabin comfort for astronauts. Not only that, someday even Mickey Mouse may use a computer to help him in and out of animated situations.



Following programmed instructions, the computer draws action sketches of typical movements made by pilots.

COLOUR TELEVISION FROM

With colour television very much in the news at the moment, this account of how the Ampex VR-7000 portable video tape recorder was modified to record colour pictures makes interesting reading. The modified VTR is able to provide acceptable colour pictures for most non-broadcast uses such as educational, industrial and home applications.

By Joe Roizen *(Ampex Corporation)*

Recording colour television signals on magnetic tape has been practical since 1958 when the first compatible colour broadcast recorders went into service. These transverse studio machines use four heads which rotate at right angles to tape travel (figure 1). The machines also contain very complex circuitry and time-base correction devices. The circuits are necessary to achieve studio-quality N.T.S.C. playbacks that meet F.C.C. specifications for on-the-air transmission; such video tape recorders (VTRs) range in price from $40,000 to $100,000 in the U.S.A.

The development of inexpensive helical videotape recorders for monochrome industrial and home applications, coupled with the current interest in colour television has led to investigations into relatively simple, inexpensive ways to adapt these recorders for colour. The pilot-carrier principle has proved a suitable system. Modifications to a normal monochrome recorder (Ampex VR-7000) and a home colour receiver make it possible to record and play back colour programs with a fidelity approximating off-air home reception.

The N.T.S.C. colour signal is composed of "interleaved" monochrome and chrominance signals amplitude-modulated on an RF carrier. The monochrome portion of the video signal requires only that the horizontal sync coming from tape have less than 15% per sec. per sec. rate change for stable optional images. This is a fairly easy-to-meet requirement for modern videotape recorders with head-drum servos. The chrominance portion, however, has a subcarrier signal of approximately 3.58MHz. The instantaneous phase of this subcarrier determines hue in the reproduced image. One cycle of the subcarrier (360°) has a 0.279μS period, and a 10° error in sub-carrier phase will produce a noticeable hue shift. 10° represents only about 8nS. Allowing for the accumulation of record and playback errors, a time base of better than 4nS is needed to reproduce faithful colour pictures. Such an extremely fine time base is not easy to attain.

Any rotating mechanism is subject to undesirable movement due to mechanical and electrical eccentricities, dynamic imbalance, walking bearings, etc. The head-drum assembly in a video tape recorder will normally display such variations in angular velocity as a time-base displacement of the reproduced signal. A monochrome picture may exhibit slight jitter, which is usually masked by the flywheel effect of the horizontal sync circuit of the home receiver. But when colour is added, the rotating head displacements show u as constant changes in subcarrie phase and the image looks as thoug it has lost colour synchronisation.

The composite colour signal use for recording in the VR-7000-A (th colour version of the VR-7000) is als fed to a burst separator which phase locks a crystal oscillator running a the colour subcarrier frequency (se figure 3). The output of the cryst oscillator is divided by 7 in a tune circuit that yields 511KHz, as show in figure 4. The 511KHz is the multiplexed at a 5 per cent level o to the FM signal applied to the re cording head. The current throug the head then has a 5 per cent pilo carrier content. The level must be hig enough to be detectable in the play back circuits yet low enough to min mise interference visibility in th reproduced image.

In playback (figure 5) the 511KH signal is recovered at the head pre amp output, and a bandpass filte isolates it from the FM signal carry ing the video information. Tw limiters amplify and clip the signal t a uniform level; the pulses now driv a Schmitt trigger whose square-wav output goes to a second bandpas filter centred at 3.58MHz, the 7t harmonic of the 511KHz pilot ca rier. The 3.58MHz is amplified an fed out of the recorder to the chomin

These diagrams show the difference in principle between transverse scanning used in broadcast quality video tape recorders and the helical scanning used in industrial models.

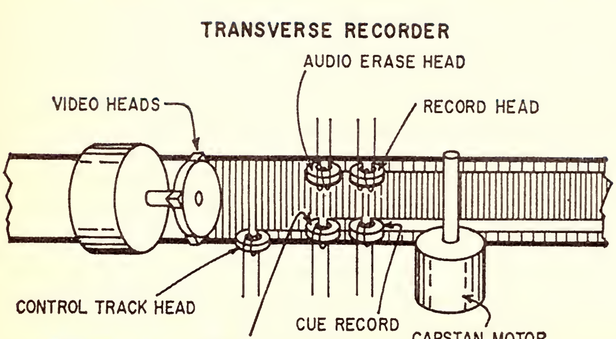


Figure 1.

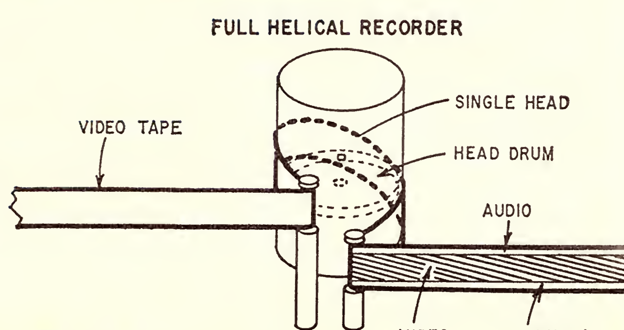


Figure 2.

ꟷELICAL RECORDER

ıce demodulation circuits of the ıodified home receiver. The set's ɤn quadrature circuits form the 0° ıd 90° signals to decode the colour ıformation.

Since the pilot-carrier signal is sub- ːct to the same time-base displace- ıent errors that the composite video gnal is experiencing, the time re- ıtionship between the pilot carrier ɜsired signal remains constant. Hence ıe colour signal can be decoded with ːasonable time-base accuracy. The ıcal oscillator in the colour receiver temporarily deactivated during VTR layback.

The signal system of the VR-7000- ɩ (figure 6) must be able to handle bandwidth of at least 4.2MHz to ot attenuate the colour sidebands. To liminate unwanted noise, spurious igh-frequency signals, etc., the input filtered by a phase-linear 4.5MHz ɔw-pass filter network.

A fast-switching multivibrator-type ıodulator converts the video signal ɔ FM. The carrier and deviation ːequencies are somewhat elevated ːom their monochrome counterparts ɔ minimise intermodulation effects etween the FM signals and the high- nergy colour subcarrier (figure 7). 'he modulator operates between .5MHz at sync tip to 6.6MHz at eak white. A rising pre-emphasis oing up to 14dB at the colour sub- arrier improves signal-to-noise ratio nd differential gain and phase. The 'M signal goes to a head-driver am- lifier which provides a constant-cur- ɜnt source to the recording head up ɔ 15MHz. A rotating transformer ɪith an 8-to-1 ratio transfers the am- lifier output to the transducer. A 0-micro-inch head gap is employed.

In playback (figure 8) a low-imped- nce preamp gives a flat frequency ɜsponse. Aperture correction and qualisation are applied to the FM ignal before 50dB of shunt limiters liminate variations in signal ampli- udes.

The output of the limiter is a constant-amplitude FM signal. A pulse-count detector and a 4.2MHz phase-linear low-pass filter convert the signal back to video and remove residual carrier and deviation components. The output amplifier feeds two 75-ohm outputs, and the RF and IF stages of the monitor (receiver) must be bypassed to provide direct access to the video circuits.

A colour-kill circuit in the VR-7000-A detects the presence of bursts on the input signal and activates the pilot carrier in the record mode. If no burst is present, the pilot carrier is shut off so that the recording will not contain the 511KHz signal. Under certain background conditions, faint vertical lines can be seen in the playback image, due to interference from the pilot carrier. The level, however, is not high enough to be objectionable and with normal image conditions, is not noticeable.

The VR-7000-A colour VTR produces acceptable colour pictures for most non-broadcast uses, such as educational, industrial and home applications. (Reproduced by arrangement with "Radio-Electronics.") ■

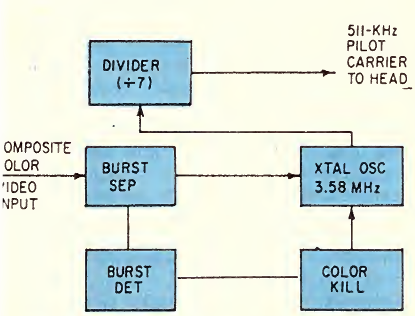


Figure 3. The pilot carrier is manufactured from the 3.58MHz reference oscillator signal during the recording process.

COLOUR TV ON DISC

Another significant advance in colour television recording technique is the development by Ampex of its HS-100 disc recording system. This is a high band colour recording system capable of providing instant replay at normal speed, or in slow motion and stop. This is made possible by the use of rare metal discs with extremely long life, in place of the conventional magnetic tape. Up to 30 seconds of action in high band colour can be recorded and played back with the new Ampex system.

For replay of significant action, any part of the 30-second recording may be cued for on-the-air use in four seconds. The system is also suitable for rapid low-cost production of colour commercials and special effects material. Its capabilities include reverse action playback at normal or slow motion speeds and frame-by-frame advance for animation or analysis of highlights. Any slow-motion speed down to stop frame can be chosen.

The HS-100 is the first model in a new class of rapid access video recording systems with the valuable capability for "instant replay" use in education, industry, medicine, government and other fields. Disc systems will be a useful complement to existing tape systems in those areas where fast access and variable playback speeds are more important than long playing time. ■

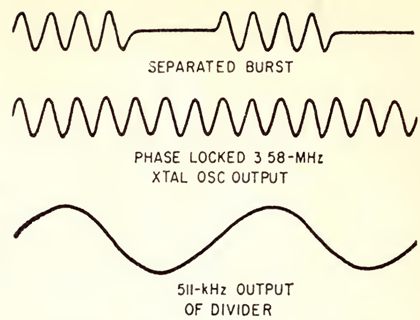


Figure 4. Burst-to-pilot relationship

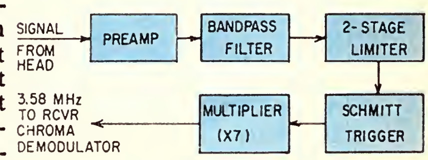


Figure 5. In playback, pilot produces burst.

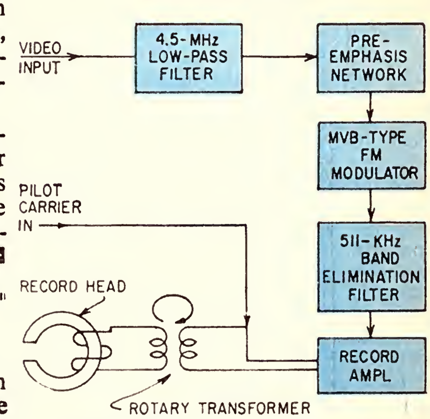


Figure 6. The VR-7000-A in record mode.

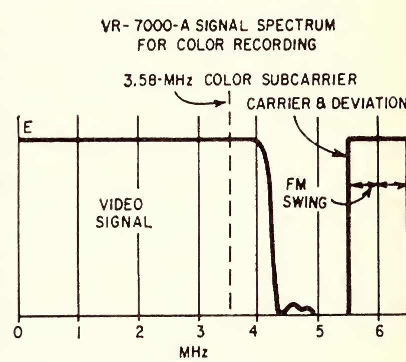


Figure 7. The colour recording bandwidth.

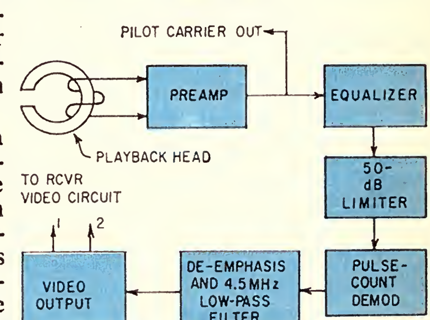
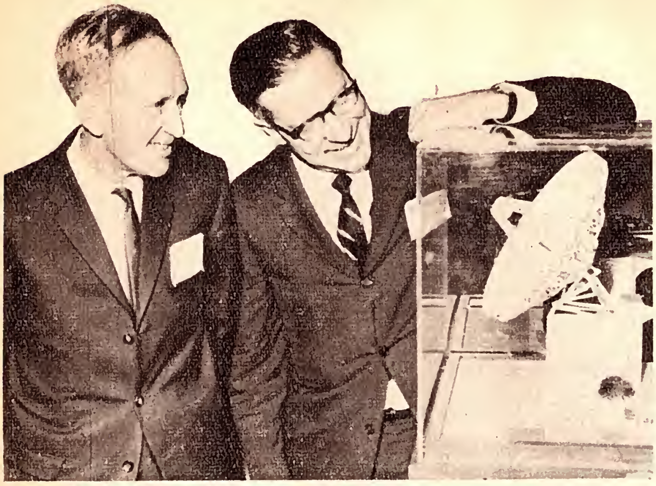


Figure 8. Playback function of VR-7000-A.



Mr Elms (right) and I.R.E.E. President Professor R. M. Huey inspect a model of a satellite receiving station at the convention display.

THE IMPACT OF SPACE

Presented at the Institution of Radio anc Electronics Engineers Convention, Sydney on May 23, 1967, by Mr J. C. Elms, Directo of the NASA Electronics Research Centre Cambridge, Massachusetts, U.S.A.

Prior to the Soviet launching of Sputnik I, on October 4, 1957, our own space plans consisted only of the launching of scientific satellites as our contribution to the International Geophysical Year—the satellites were of a size later ridiculed by Khrushchev as "grapefruit satellites." The United States was startled and shocked when the Soviet Union not only put up the first earth satellite, but one which weighed 184lb, considerably larger than anything we even contemplated. We accelerated our own program, but the Russians continued to orbit increasingly larger weights. At the time that NASA was organised in 1958 Russia had placed in orbit a satellite weighing almost 3,000lb. Our best effort up to that point weighed less than 40.

During that year of 1958, the United States tried to launch 13 satellites, but only five of them worked. Since that time, however, we began to have increasing success. By 1961, we had 54 successful flights, with five successes for each failure. Since 1963 our record of successful launches has been in the neighbourhood of 90%.

In those early years of the space age, we were limited in what we could do by the lack of launch vehicles capable of putting substantial payloads into space —and by the existing level of technology, as well as by inadequate knowledge of the space environment.

As progress was made on many fronts our understanding of the potential of space grew, and it became possible to raise our sights and identify more clearly longer-range goals. As you know, the Gemini program was successfully completed last autumn. During this program we put 20 men in space in 20 months. The program demonstrated rendezvous and docking and extra-vehicular activities of increasing difficulty. Three unmanned flights in the Apollo program demonstrated the performance of the uprated Saturn I launch vehicle, the Apollo heat shield, and the Apollo propulsion and navigation systems. The tracking station at Carnarvon played a most important part in the success of all these missions.

Two Surveyors have made successful soft landings on the moon and have sent back data of great importance. We have obtained Apollo landing site pictures from each of our three Lunar Orbiters. The cameras in the Lunar Orbiter also took pictures of the earth while it was in orbit about 750 miles from the moon's surface. The Woomera Station and Tidbinbilla, each functioning as part of a sub-net devoted to working with the appropriate spacecraft, performed beautifully. They received the data which produced spectacular and valuable pictures. All three of these programs, Gemini, Surveyor and Lunar Orbiter, have provided us with information essential to the projected moon landing.

During the past year the Orroral Valley Station obtained scientific data from about 40 satellites which measured the earth's magnetic and gravity fields, the characteristics and details of various radiation in space, atmospheric phenomenon, and other data which are helping us to understand better the environment which governs our planet. The Honeysuckle Creek Station is the newest member of the 16-station network which was implemented to support the manned Apollo mission. Honeysuckle Creek, together with two similar stations located 120° apart around the earth, at Goldstone Lake, California, and at Madrid, Spain, will give continuous coverage of the Apollo spacecraft from the time it leaves orbit of the earth, out to the moon, and back. These stations are equipped with 85ft-diameter dish antennas and provide tracking, communications and command.

They will receive communications from the astronauts when they are on the surface of the moon and will also receive scientific data from the moon emanating from experiment packages which the astronauts will leave on the surface of the moon. When the spacecraft returns and resumes earth orbit altitude, Honeysuckle Creek and its two sister facilities in California and Spain will return the communication responsibility back to the 11 network stations and two tracking ships which are equipped with 30ft-diameter antennas for near-earth and re-entry support. The Australian Government has provided additional assistance by making available physicians to serve as medical monitors at the tracking stations during manned flights. In addition, a number of Australian airfields have been used as staging area for recovery aircraft. These ar some of the things for which I extend t you our thanks.

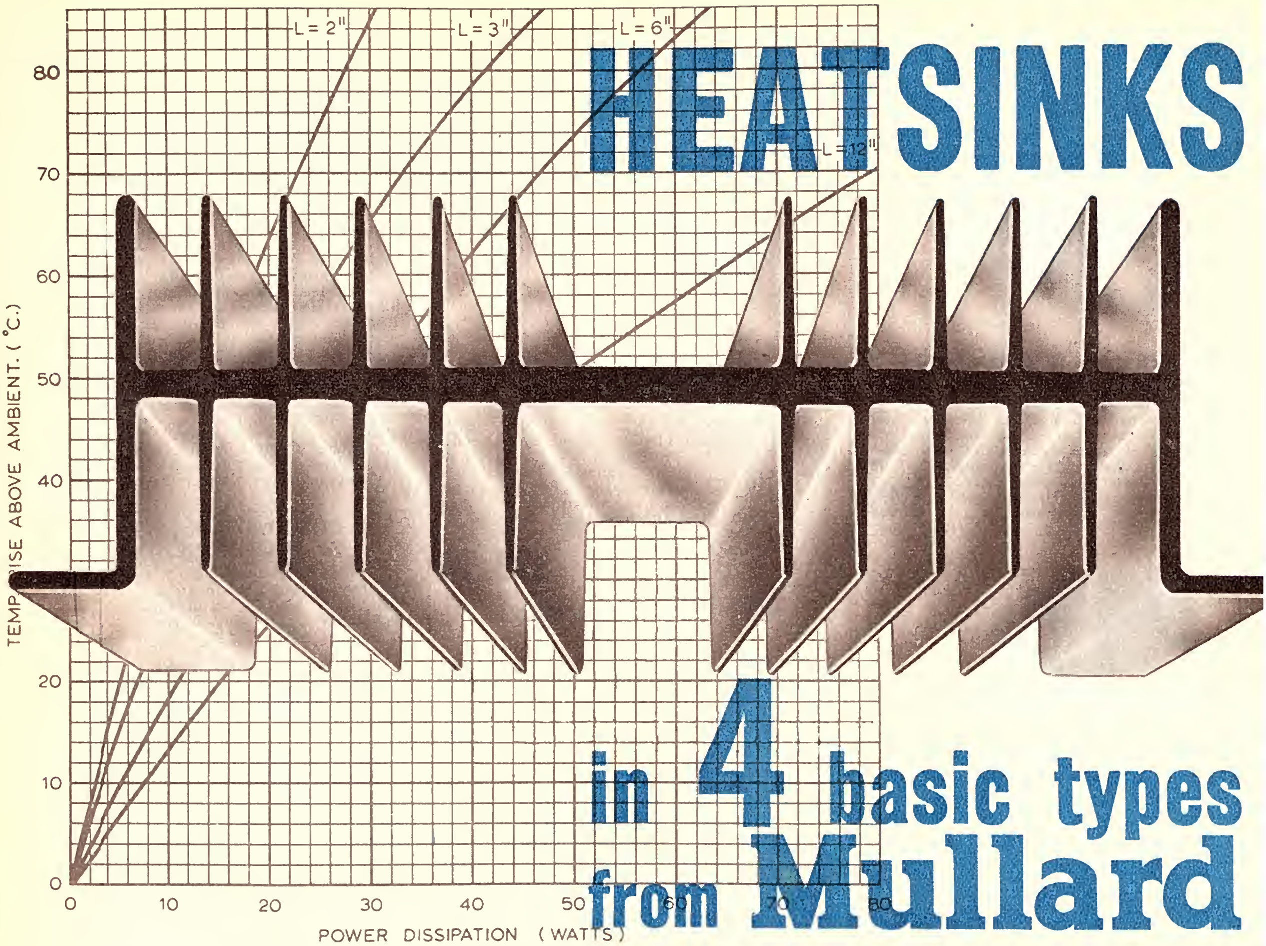
I am happy to say, however, that no' we have jointly entered the era wher the U.S. can give Australia more tha thanks—where we begin to pay you bac for your efforts with something mor substantive than words.

At Toowoomba you have a prim command and control station for th Application Technology Satellite (AT: series. This station provides us visibilit of the satellite at that critical momen when we position it in synchronous orb at an altitude of 22,300 miles. We hav now reached a point in the space pro gram where we can think beyond sing purpose missions. The ATS carries variety of space applications experimen in communication, meteorology, naviga tion and air traffic control, as well a environmental measurement experiment

For instance, ATS I is permitting u through its spin scan camera, to photo graph the cloud-cover over the Pacifi the eastern coast of Australia, and th western coast of North and Sout America. We have been receiving abou 20 cloud pictures a day over this are This information comes into our ow weather bureau and is combined wit other information such as ESSA satelli data and ground derived data. By pro cessing all these data, we can put to gether relatively long-range weather for casts and weather maps. Furthermor we can use the same satellite to sen these facts back to all the stations th are in line-of-sight of the satellite, in cluding, of course, Toowoomba.

At times it is difficult to contact ai craft flying over the wide reaches of th ocean because of the effects of varyin atmospheric conditions. Using the AT we have for the first time been able t establish experimentally continuous cry tal-clear two-way voice communicatio between aircraft over the wide reach of the Pacific and ground control statio on either side. The potential for worl wide air traffic control systems is indee obvious. It is especially significant t future supersonic transport operations.

In addition to being involved in th ATS weather program, Australia als receives directly from U.S. satellite twice a day, weather information in th



HEATSINKS in 4 basic types from Mullard

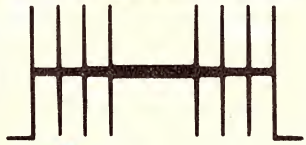
The Mullard preferred heatsink extrusions listed below are manufactured in Australia and offer design engineers "off the shelf" heatsinks for most power semi-conductor applications.

Type	Standard Lengths	Finish
35D	2" 3" 4" 6"	Anodised
45D	3" 4" 6"	Anodised
55D	4" 6" 8"	Anodised
65D	4" 6" 8"	Plain

Bulk material is available in 36" and 72" lengths. Non-standard lengths, subject to quotation, can be supplied in minimum quantities of 100 pieces. Further details are available from Mullard offices throughout the Commonwealth.

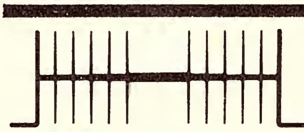
1 35D

For use with lower power transistors and silicon diodes.



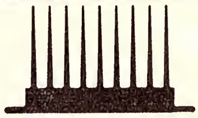
2 45D

For use with medium power transistors, thyristors and silicon diodes.



3 55D

For use with high power transistors, thyristors and silicon diodes.



4 65D

For use with high power thyristors and silicon diodes under transient current conditions.

Mullard

MULLARD-AUSTRALIA PTY. LTD. • 35-43 CLARENCE STREET, SYDNEY, N.S.W., 29 2006.
123 VICTORIA PARADE, COLLINGWOOD, N.5, VIC., 41 6644
Associated with MULLARD LIMITED, LONDON

M204

form of pictures showing cloud cover over Australia. The photographs are received by three automatic picture transmission (A.P.T.) stations in Melbourne, the University of Melbourne, and the W.A. Institute of Technology. I understand that three more A.P.T. stations are currently being installed in Darwin, Perth and Newcastle. I hope that the increasing number of meteorological data which will become available will be as helpful to the Australian economy as similar data have been to the U.S.A. For example, the U.S. Chamber of Commerce recently estimated that in its first year of operation alone, weather satellite forecasting has resulted in a saving of about $2½ thousand million.

Now, about our projected earth resources satellite program, particularly with regard to how this program may be valuable to your country in the near future in the important area of water resources management: It is my understanding that modern irrigation programs which have been established in N.T. have given indications that a tenfold increase in productivity can be achieved in both crop and livestock production by careful management of available water. Obviously it could be extremely important to your economy if you were able to locate additional water supply.

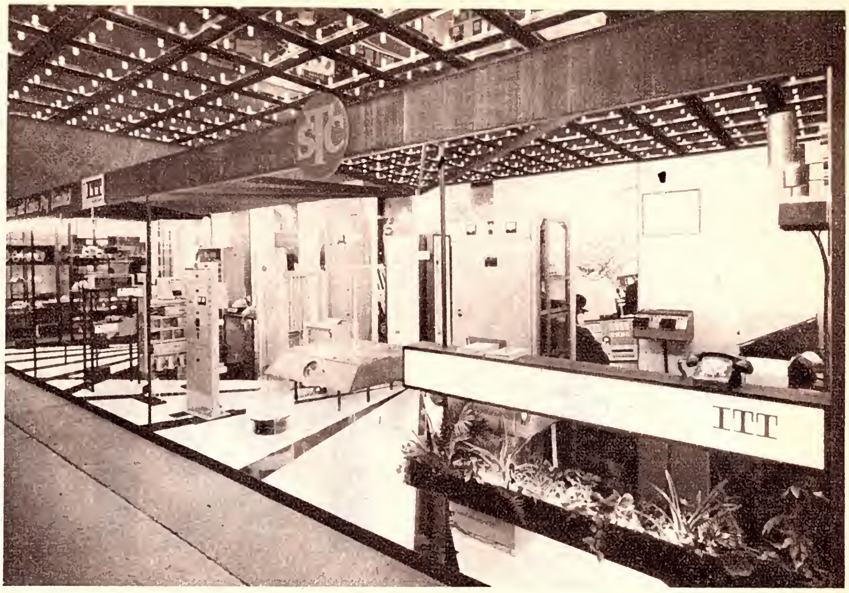
The experiments performed so far in our aircraft program have been very encouraging in this regard. Near-surface underground water has already been detected by infrared-photography. Deeper underground water can be located in some cases using a combination of optical, infrared and radar mapping techniques. In addition, sensors are available which can gather information on the density of vegetation, and on soil temperature and moisture. They may be used to distinguish a healthy crop from a diseased one and perhaps even point up the cause of crop diseases. Undergrazed and over-grazed conditions can be detected and, therefore, corrected. The productivity of the fishing industry may also be influenced by recording the movement of plankton and other variables affecting the migration of fishing grounds.

Unfortunately, it will be after 1970 when the global earth resources satellite program will become operational. Meanwhile, I hope interested Australians will visit the U.S.A.—to study our precurser aircraft earth sensor program—and to give us any advice that they think might be helpful in the development of the operational satellite system.

Some of our critics in my country have said that the space program diverts scientific and technical personnel from their normal occupations and goals, and is, therefore, damaging to the remaining sections of the economy. Most of us feel, however, that it is quite the contrary. We can say with increasing confidence that the peculiar quality of space science and technology provides a stimulus and an accelerating force for joint progress in a wide range of disciplines—astronomy, biology, geology, geodesy, mathematics, meteorology, physics, and others at their newest frontiers and, with the benefit of new tools, the rocket and the satellite.

Space technology is the practice of the established technical disciplines, including electronics, materials, structures, fuel, propulsion, communications, data handling and power sources under extremely severe conditions. The opportunities for scientists and engineers in our space program have obviously had

STC CONVENTION STAND



Typical of the many excellent displays erected by companies participating in the equipment exhibition during the I.R.E.E. Convention was the STC stand, which featured radio transmission, data systems and line transmission equipment, as well as a wide range of components. A focal point of interest in this display was a 1/50th scale model of the high power rotable HF log periodic aerial designed in Australia for long and medium range communications with fixed or moving stations.

a beneficial effect on universities in the U.S.A. I hope that Australian universities will have an increasing opportunity to participate in your space oriented activities as they develop.

Much has been said about the so-called race to the moon, involving Russia and the U.S.A. In the many discussions concerning the great expense involved, some of our critics forget that the lunar landing is not an end in itself but instead it is a focus for national effort. In this and other space programs, we are developing the tools and the minds and the strengths for future and greater enterprises. So also are the Russians; but I hope and believe that the space program can continue to be a substitute for the forcing element which was formerly provided only by great world wars—witness the development of the airplane and of nuclear energy as two examples.

Earlier I discussed the Apollo network — the unified S-band system in which Australia plays such an important part. It is interesting to note that an earlier NASA development, the communications satellite, now in its operational phase, will play an essential part in the Apollo development program. Furthermore it is an example of NASA's basic role in space. NASA is a research and development organisation, not an operational one. As the weather satellites have become operational they, like the communication satellites, have become the responsibility of another agency. Meanwhile NASA continues development of advanced systems to give the forecaster better tools such as multi-spectral imaging in Nimbus II.

Looking further into the future of weather satellites we can see the requirement for new technology in the area of sensors such as microwave radiometers and spectrometers as well as supercooled IR detectors; and in improved spacecraft equipment such as long life three axis stabilisation; and in data storage, processing and transmission. Also basic research is needed on new approaches for remote sensing of the atmospheric parameters.

Although, I've only mentioned the word "electronics" once, I've been talking about electronics a great deal. Almost one half of NASA's money is spent on electronics and data handling —over two thousand million dollars per year! When I talk about requirements for the future I am talking about requirements for electronics.

No new technology requirement, whether it be for more efficient communications systems, for more accurate stabilisation and control systems or for more sensitive instrumentation can overshadow the most basic requirement for electronics with a much longer assured lifetime. One of the biggest limitations to longer duration flights is the reliability of electronic components and system. The best way to increase reliability is to design longer life into the basic devices. I don't want to downgrade the importance of system design in general or of redundancy in particular, but if you want something to work for five years you should design it so that you have every reason to expect it to work five years. Then and only then should you add redundancy to assure it's doing so.

The same design improvement which will permit longer duration missions will assure safer ones. These same improvements will reduce program delays and launch failures and will increase the probability of mission success. Last, but by no means least, greatly increased reliability of electronics is an essential requirement to reduce the cost of both the development and operational phases of the space program. Only by so doing can the advances in science and technology now being achieved be completely exploited for the economic and sociologic benefit of man.

TRIAC

A NEW SEMICONDUCTOR SIMPLIFIES AC FULL-WAVE CONTROL CIRCUITS . . . REDUCES CIRCUIT SIZE AND COST

Now the same General Electric technological leadership that over the years has brought you the Silicon Controlled Rectifier, the Controlled Avalanche Rectifier, high-current silicon rectifiers and many other important improvements in power semiconductor designs . . . makes possible TRIAC.

TRIAC is a new three-electrode AC semiconductor switch which is triggered into conduction in either direction by a gate signal. It's actually a power "integrated" circuit, basically related to the SCR.

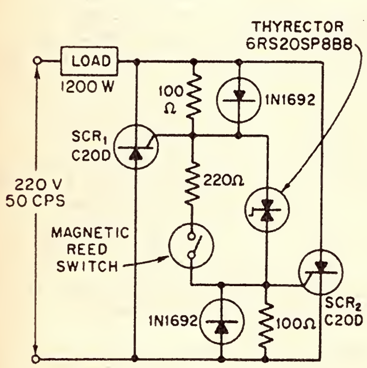
TRIAC simplifies control of full-wave AC power by *reducing the number of power-handling components;* by generally eliminating need for transient voltage suppression; and by reducing size and complexity of gate-control circuits.

Compare the two circuits below. Both show a full-wave AC static switch. The one on the left — the more complex—uses multiple SCR's. The simpler circuit on the right uses a single TRIAC.

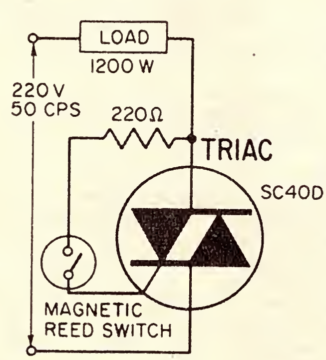
If you're interested in applications such as static power switching, temperature controls, lamp dimming or motor-speed controls, you should look into TRIAC.

It's available now, ex stock, two current ratings; 6 amps and 1 amps both at 400 volts.

For further information, see your G representative or write *Australia General Electric Pty. Ltd., 103 Yo Street, Sydney, N.S.W. — 29 871 552 Lonsdale Street, Melbourn Victoria — 67 8221.*



This circuit can be simplified . . .



to this

STOP PRESS!
TRIAC RATED AT 15 AMPS
NOW RELEASED!

Progress Is Our Most Important Product

GENERAL ELECTRIC

TRADEMAR

IG5'

Technical Review

AUTO DRIVER MAY PREVENT ROAD ACCIDENTS

With road deaths increasing each year, and more and more people being crippled in road accidents, anything which promises to contribute to road safety merits serious consideration by every road user. In this context, the news that a Japanese company has invented what they believe to be the first devices to keep drivers out of trouble by automatic means is of special interest.

Mr Densaburo Masuda is an elderly okyo businessman with an uneasy onscience about a serious social prob- :m in Japan: the motor car. Japan al- :ady has nearly 10 million cars, of hich about one-seventh are registered ı Tokyo, where 788 people died in road :cidents last year and another 58,454 ere injured. At every police station the revious day's toll is prominently displayed. Masuda anticipated the menace 4 years ago when he sold his string f 20 English racehorses to finance a rivate dream — a research laboratory iat might make a serious contribution) road safety.

"Most traffic accidents" Masuda said, are caused by speeding or overloading." few weeks ago his laboratory an- ounced its first big contribution, a sys- :m whereby the top speed of a vehicle automatically kept below a predeter- iined figure. Very soon now he hopes) announce a technical solution to the roblem of the overloaded vehicle — in ie case of dump trucks and forklift ucks often overloaded three-fold in apan, he asserts.

The MEL automatic speed regulator, s they call it, has been developed intly by a mechanical engineer, Shig- ru Kondo, of the Masuda Electric Lab- ratory in Tokyo, and an electrical en- ineer, Minoru Moriya, of the Tsuken lectric Industrial Company in Sendai. heir idea is to impose a top speed mit upon the vehicle, beyond which ie vehicle is automatically slowed down, r braked if need be. At its simplest, iis control is exercised "voluntarily" by ie driver, who merely pushes a button n his dashboard to select his own top eed (in Japan the limit is 80 kilometres n hour, but speeds of 40, 50, 60, 80 or)0KM/hour can be pre-selected).

But the real point of the MEL utomatic speed regulator, is not to :ave it to the driver but to impose an ver-riding control from the pavement. Ioriya has developed a miniaturised ansmitter with a range of 300 metres – "the key to success," say his colleagues — that relays "instructions" to the vehicle. If the car enters a zone of restricted speed too fast, shortwave radio signals promptly close the throttle, and continue to override the driver's foot until the vehicle has slowed below the speed limit. A whole range of instruction can be relayed to the car in this way, so that it takes the appropriate action when approaching for example traffic lights, pedestrian crossings, no-passing signs, or icy road conditions. A simple extension of the scheme would allow tape-recorded instructions to warn the driver, audibly, of traffic signals and conditions ahead.

The heart of the MEL paging system's transmitter is a miniature oscillator called the Minifork developed by Tsuken Electric, which can hold its frequency to within four parts in 10,000 at room temperature (no frequency has yet been allotted for traffic control, of course). The idea is that the transmitter would be attached to or built into the traffic sign itself, at a cost the inventors believe of around $250 a time. The receiver, small enough to be fitted within, say, the thickness of the door, might be mass-produced, along with the mechanical coupling that disengages the accelerator, for about $75.

Mr Masuda's own white Cedric has been fitted for self-policing with the minimum system, and has completed 5000KM without trouble. It is said to slow the car abruptly, almost with a jolt, when a person tries to exceed the speed pre-selected on its dashboard. There is no need for any modification of the engine, and there is no effect upon the performance of the engine. The system has been undergoing public trials on the Funabasni Circuit, a race track north of Tokyo. Patents have been granted in Japan, and are sought in Britain and seven other countries.

The MEL system, plainly, is still experimental; but it works. It remains to be engineered for mass-production. The big obstacle, however, is that any significant advantage could emerge only if the system were to be adopted officially, and applied compulsorily to all vehicles. To this end Masuda and his colleagues have high hopes of influencing the Transportation Ministry, whom they claim has smiled favourably upon their ideas.

At the same time Mr Masuda, thinking nostalgically of that string of English racehorses, has hopes that Japan and Britain might collaborate in solving mutual social problems, traffic among them. ("New Scientist," 18/5/67.)

TRAFFIC LIGHTS THAT "THINK" AID U.K. DRIVERS

The dilemma of the driver who finds the traffic lights changing aspect as he approaches them at speed may have been eliminated by a system devised by the British Ministry of Transport's Road Laboratory scientists.

With this system, traffic lights will not normally change to amber in circumstances when a driver might have difficulty in stopping safely and comfortably at the stop-line. No extra signals are involved and there is no alteration to the normal three-second amber period.

The equipment consists of detectors which measure speed, placed about 500 feet from the stop-lines on the high-speed approaches, and computing devices which estimate the time that each vehicle will enter its critical section. When a vehicle enters this critical section, the signal is held at green until the intersection has been negotiated, except when the green period has already been extended to the maximum time allowed.

After successful preliminary trials on the Kingston By-pass a prototype model has been constructed in association with Automatic Telephone and Electric Co. and Siemens and General Electric Railway Signal Co. Ltd. which is now under test. Equipment of this kind, which can be coupled to normal vehicle-actuated signal controllers, will be in production shortly.

The system and equipment are described in a Road Research Technical Paper (No. 74). It is available from H.M. Stationery Office.

INTELSAT III WILL COMPLETE WORLD-WIDE SATELLITE COVER

The transmission of live television pictures between Bri- ıin and Australia via a communications satellite in Novem- er last year focused public attention on what is, in fact, ıe second phase of a global satellite communications scheme lanned to be complete by 1968. Telephone, television and :leprinter signals will be carried. This global system is eing set up by the International Telecommunications Satel- te Consortium (Intelsat), a partnership of 55 nations, and ıe second phase of the scheme is now under way. The rst phase of the project was the coming into service of the :arly Bird synchronous satellite in 1965. Phase II was esigned to provide two additional synchronous satellites, ne over the Atlantic and one over the Pacific (figure 1). :ach has the same channel capacity as Early Bird but ives about twice the radiated power and has a larger ervice area.

The satellite intended for the Pacific was launched in)ctober, 1966, but the apogee motor failed to put it into ıe required geo-stationary orbit 22,300 miles above the arth and the spacecraft is now travelling in an elliptical rbit. It was while this "rogue" satellite was temporarily bove the Indian Ocean that it was in a suitable position ɔ allow the Britain-Australia television relay. While it was ver the Atlantic it enabled two-way telephone communi- ation to be established between the Cable and Wireless round station built by Marconi on Ascension Island and ıe American ground station at Andover, Main. In the atellite, the receiver operates in the band 6.285-6.405GHz nd the transmitter in the band 4.060-4.180GHz.

A replacement for the "rogue" Pacific satellite was sub- equently launched—modifications having been made to the pogee motor design—and was followed shortly by the Atlantic satellite. Meanwhile, Early Bird continues to operate, and will be in use up to 1968, when the third phase, using Intelsat III satellites, will come into operation. (If Early Bird fails before 1968 it will be replaced.) The combined capacity of Early Bird and the new Atlantic satellite will allow trans-Atlantic television transmission without interruption of other communications.

Phase III will provide three new satellites, one above the Atlantic, one above the Pacific and one above the Indian Ocean. Each will have a capacity of 1,200 voice channels. Their positions are not yet known but the Atlantic satellite will probably be further west than Intelsat II satellite shown in figure 1. A significant feature of this phase for the U.K. is that the Indian Ocean satellite will allow communication between Britain and Australia, using the U.K. Post Office's ground station at Goonhilly, Cornwall, and a ground station to be constructed by the Australian Overseas Telecommunications Commission. As can be seen from figure 1, Goonhilly and much of Australia are within the limits of the service area. These limits are described by points on the earth's surface from which the satellite appears to be just above the horizon (see top-left sketch in figure 1). More precisely they are points on the globe where the angle of elevation of the ground station's aerial bowl when directed at the satellite is 5 degrees (relative to 0 degrees, the horizon)—an angle which Intelsat have agreed as the lowest economic one for adequate signal/noise ratio.

The capacity of the Intelsat III satellites will be taken up during the 1970s. In general the satellite scheme will be complementary to the existing coaxial-cable long-distance telephone network — satellite communications becoming relatively more economical with increasing distance. An important factor in the timing of the whole system is the U.S.A.'s Apollo space project for eventual landing of men

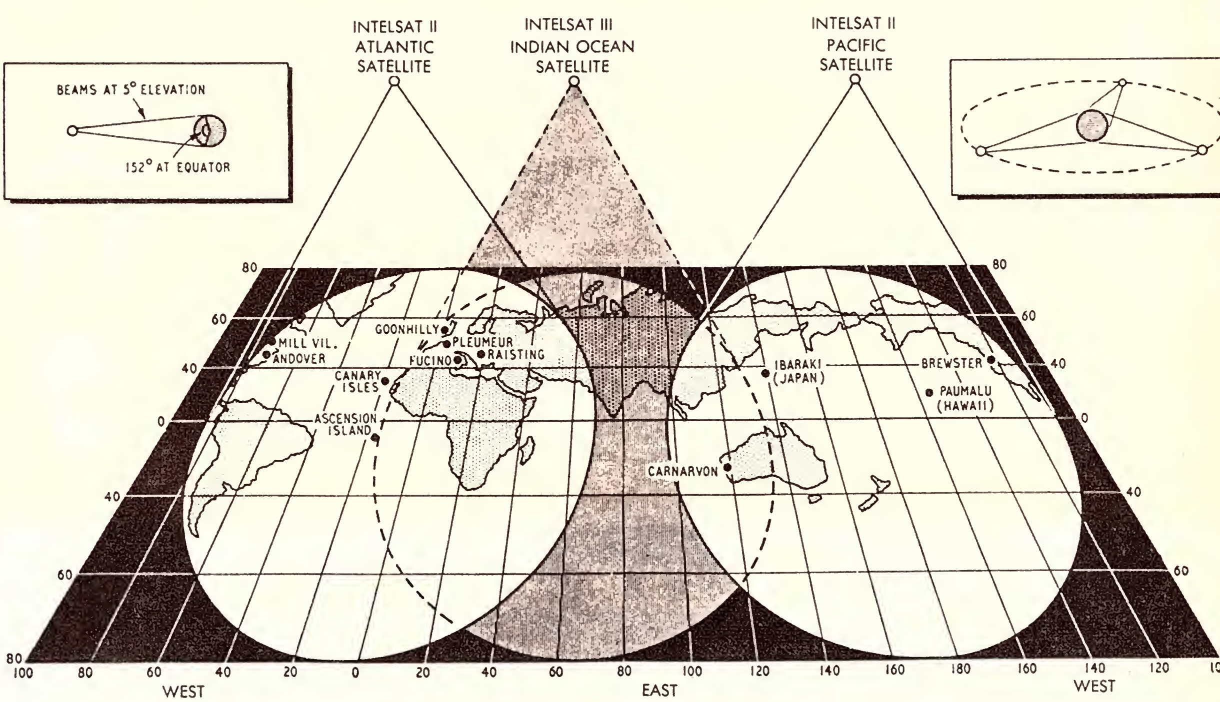


Fig. 1. Estimated service areas of Intelsat II Atlantic and Pacific satellites and probable service area of future Intelsat III Indian Ocean satellite. The Intelsat III Atlantic and Pacific satellites will have roughly similar service areas to those of the Intelsat II satellites but the Atlantic services area may be about 20 degrees further west.

n the moon. This will require global telecommunication nks between the various radio stations tracking the pacecraft, and the Atlantic and Pacific satellites ill be needed by NASA to supplement existing cables nd HF radio systems. Ascension Island, mentioned arlier as an earth terminal station, is one of three places t which fixed Apollo tracking stations will be operating he other two being Carnarvon and Grand Canary Island). . further six tracking stations will be mobile — on land r shipborne. About half of the capacity of the two Intelsat 's will be used for the Apollo project and the remainder ill be available for routine commercial communications.

The two Intelsat II satellites have been constructed by e American firm which built Early Bird (HS303)—Hughes ircraft Company. These Intelsat IIs are twice as large as arly Bird, have over twice the radiated power, serve a rger geographical area and unlike Early Bird, provide for ultiple-access working (meaning that a number of ground ations can work through a satellite simultaneously). The icrowave relay station of the craft consists basically of a ceiver operating over the band 6.285 to 6.405GHz, a equency changer which changes the received signals by 225GHz and a transmitter radiating the frequency-changed gnals in the band 4.060 to 4.180GHz. In the transmitter our 6W travelling-wave tubes are provided. One, two or ree of these in any combination may be turned on and perated in parallel, according to the power available from e solar-cell and nickel-cadmium battery power supply (nomi- ally 85 watts). Normally two or three TWTs will be in peration, even when the earth obscures the sun. These ansmitter output tubes feed a four-element biconical horn erial array, which has virtually constant gain across the ass-band, to give an ERP from the satellite of about 25 atts for multiple-carrier working or 35 watts for single- rrier working. Since the aerial array has a toroidal beam it ontinually illuminates the service arc on the earth while the tellite is spinning on its own axis (the spacecraft being in-stablised).

Within the 125MHz bandwidth of the relay station, 240 vo-way voice channels or one television channel can be ccommodated. The cost of operating one two-way voice hannel is at present about $35,000 p.a., but this is likely drop as satellite communications become established. transmission time delay of 270ms in each direction is herent in the system, and this means that two such satel- te "hops" used in tandem would make telephone conver- tions extremely difficult.

The craft's telemetry system, for monitoring and con- olling the satellites from the ground, is similar to that of arly Bird and comprises two encoders, two VHF transmitters which are turned on and off from the ground) and a radio eacon (which radiates continuously). Control of the tellites — positional control through gas jet system and ontrol of the radio system — is the responsibility of the ommunications Satellite Corporation (Comsat) in the .S.A., which acts as manager of the whole scheme for ntelsat. Commands are sent from Comsat's operations entre in Washington, D.C.

The Intelsat III satellites are being constructed by the merican company TRW Systems, and six are on order. hese will have slightly greater transmitter power than that f Intelsat II but, because the aerial beam will not be an ll-round" toroidal one but have all the radiated energy irected in a cone towards Earth, the ERP will be sub- antially greater — about 100W in fact. This directional eam will be achieved by an "electronically despun" erial system which will counteract the effect of the stabilisa- on spin of the satellite by cyclically switching the RF nergy to the aerial elements as the satellite rotates. The reater capacity of these satellites will be provided by the ider bandwidth of the microwave relay stations — 500MHz nstead of Intelsat II's 125MHz — the receiving band eing 5.935 to 6.425GHz and the transmitting band 3.700 4.200GHz.

On the ground a number of stations are, of course, lready operating through Early Bird, but many more are nder construction and projected. Those already built or n course of construction are: Andover (U.S.A.), Brewster lat (U.S.A.), Buitrago (Spain), Fucino (Italy), Goonhilly J.K.), Ibaraki (Japan), Bill Village (Canada), Paumlu Hawaii), Pleumeur Bodou (France), and Raisting (Germany). lthough primarily for use in the Apollo project, the follow- g stations will also be available for commercial communi- ations: Ascension Island (British), Grand Canary Island Spanish) and Carnarvon (Australia). In addition, there are

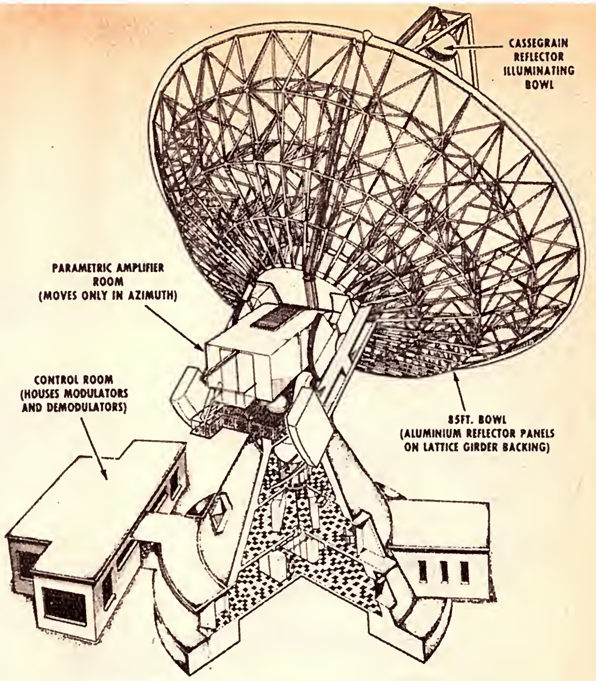


Figure 2. Earth satellite station designed by the A.E.I./G.E.C./Plessey consortium.

plans to build stations at Hong Kong, Bahrein (Arabian Gulf), Moorefield (U.S.A.), Moree (Australia), in the Carib- bean, and second installations at Goonhilly and Andover. Countries with definite plans to build stations include Thai- land and the Philippines, and further possible sites are Nigeria, Ethiopia, the Middle East, Chile, and East Africa.

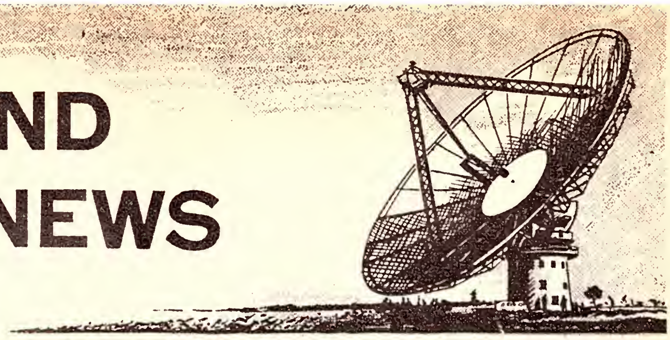
It has been estimated that 80 to 100 new ground stations will be needed over the next few years. This, of course, represents considerable business for the manu- facturers (each station costing $2.5m or more), and on the strength of it a new company, World Satellite Ter- minals Ltd., has been set up in Britain to specialise in building and installing these stations. Formed as a consortium by A.E.I., G.E.C. and Plessey, W.S.T. have produced a standardised basic design for a ground station and have tendered for the Hong Kong and second Goon- hilly terminals. One feature of their design (figure 2) which uses an 85ft Cassegrain aerial reflector system, is that the "pre-amplifier room" containing the parametric amplifier first stage of the receiver is mounted so that it does not move in elevation when the bowl is tilted. This allows the equipment in the room to be continuously acces- sible to the engineering staff while the station is operating. The aerial bowl, as in other designs, is made steerable to permit tracking of non-synchronous satellites, or of syn- chronous satellites with slight positional variation (when the orbit is not precisely over the equator), or to allow the station to operate with two different satellites at different times. Maximum rate of movement is 1 degree a second. The aerial has a beam width of 0.2 degrees and can be posi- tioned with an accuracy of 0.03 degrees.

Most of the ground stations in use or being built have reflector bowls 85ft in diameter. This is the minimum size necessary to satisfy a receiving-performance figure of merit recommended by Intelsat:—

$$\frac{\text{Aerial gain}}{\text{System noise temperature in deg. K.}}$$

expressed in decibels. In the W.S.T. station, for example the figure of merit achieved is 40.7dB with 5 degrees aerial elevation at the reception frequency of 4GHz. The basic problem is, of course, the strictly limited radiated power from the satellite and the irreducible noise level of the system (sky noise plus man-made radio interference plus receiving equipment noise). In practice this means that the aerial bowl should be 85ft in diameter to collect sufficient RF energy from the satellite, the station should not operate with the aerial beam lower than 5 deg. elevation, as mentioned earlier and the system noise temperature must be brought down to 50 to 60 degrees K. ("Wireless World," February, 1967).

SCIENTIFIC AND INDUSTRIAL NEWS



\ustralia's World Weather Centre

Weather information of vital importance to Australia's imary industries, airlines, shipping, and others, will soon be ocessed by a new computer centre. The Commonwealth Bureau Meteorology will install the computing facility in Melbourne ing a large IBM computer complex costing about $4 million. ıe new centre will be linked by a communication system with eteorological data sources and information users throughout ıstralia and overseas. It will play an important role in the 'orld Weather Watch, with the responsibilities of a World eather Centre, together with similar centres in Washington and oscow, exchanging global weather data and charts.

To help local weather forecasting, the computer will process ntinuously data from nearly 1,000 stations supplying meteorolocal observations from Australia and the adjacent regions. With ese data, the centre will assist in issuing forecasts — including ırnings of weather conditions likely to be dangerous — plot eather charts, compile lists of selected observations, carry out atistical processing, and generally apply the latest principles data processing to the Bureau's main functions.

Electronic equipment in the centre will include two identical ocessors with high speed printers, and magnetic disc drives pable of storing and keeping up to date vast quantities of eather data. The peripheral equipment will also include magnetic pe units, visual display stations capable of retrieving and disaying in seconds tabulated weather data. Graphic plotting uipment linked to the central processor will automatically plot eather charts showing the movement of weather patterns over ustralia and adjacent geographic areas.

The complete computing and communication system will not come operational for some time. It will be installed in two ıases over a number of years, starting in mid-1968.

:lectronic telephone exchange

Europe's first regular electronic telephone exchange was ›ened at Ambergate in England recently. The British Post Office ıs placed further orders for similar exchanges but, at the same ne, has placed large orders for electromechanical crossbar uipment. For future projects, it has standardised on electronic changes up to 2,000-line capacity, but will still depend on odern crossbar equipment for larger exchanges.

The exchange at Ambergate is not fully electronic in the nse that there are no moving parts. All control circuits are ectronic, but the mechanical crosspoint still depends on physical ovement for operation. Totally electronic exchanges with no oving parts have been tested under operating conditions in the nited States and Britain. However, in recent years there has en a swing from total electronic switching to mechanical crossint with physical movement.

Australia may not see the introduction of electronic exıanges for several years, but the Australian Post Office will ırefully evaluate reports on the performance of the Amberıte exchange. There appears to be no reason why electronic changes will not readily be integrated into the existing lephone network.

:nlarged University Computer Systems

Control Data Australia Pty. Ltd. has contracted to supply lditional computer equipment to Monash, Sydney, and Western ustralian universities at a total cost of over $200,000. The first the equipment has already been delivered.

The computer system at Monash is being doubled in capacity by the addition of an extra 16,384 words of central memory and two data channels. Two disk drives, each of 4 million characters, are also being added. The system installed at Sydney University is being enlarged with the addition of six telegraph terminal units, two disk drives each of 8 million characters and a C.R.T. display station. The University of Western Australia has also ordered two disk drives of 8 million characters to add to their computer.

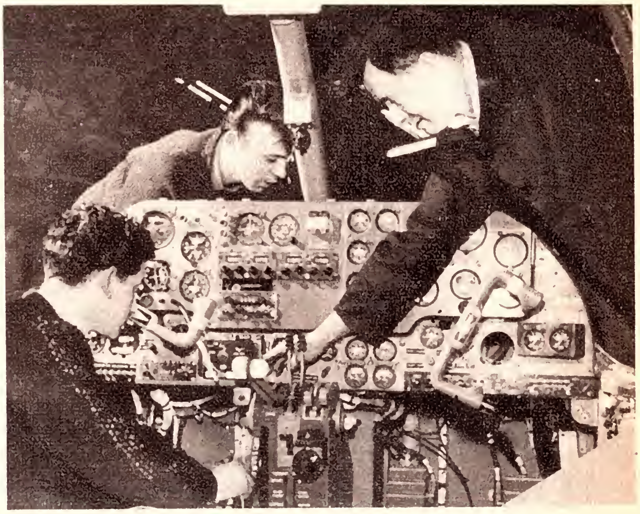
Simpler computers now possible

Original research work carried out at Edinburgh University may lead to computers which are smaller, faster and much cheaper than existing types, according to a report in "The Scotsman." Professor W. E. J. Farvis, and a microelectronics team at the university have discovered a method of drastically simplifying the complex communications system within a computer. Basically, the principle of the Farvis team's work is a simple one, making use of basic bulk effects in semiconductor material — in this case a thin film of cadmium sulphide atoms evaporated on to a glass slide. A minute piece of this material should ultimately replace the complicated integrated circuits now widely used in computer circuitry.

Stable high electric field domains (clusters of electrons) are launched across the cadmium sulphide with the application of voltage. If a domain moving through the material encounters changes in conductivity due to doping or changes in cross-sectional area, the current through the slide also changes. By specifying the conduction paths in this way, it is possible to produce an output current with a waveform of almost any shape. The new concept has been named DOFIC (domain originated functional integrated circuits).

Although the silicon integrated circuit is reliable and reasonably cheap, the fabrication process is fairly complicated. The advantage of the new method being developed at Edinburgh is its simplicity. For instance, the pulse generator is an integral part of a digital computer, but at the moment it takes as a minimum, two transistors, at least four resistors and three capacitors to make one pulse generator. With the DOFIC circuit, every time a domain sweeps across the DOFIC element it can generate a pulse corresponding to a notch cut into the profile. In fact a pulse code can be generated if more than one notch is cut into the element, giving an easy way to generate binary numbers. Because the domains travel through the element very quickly (at something like 10,000,000 centimeters per second) an extremely short pulse is generated. Short pulses mean very much faster computers.

At the present stage of development of the system, the thin



Electricians wiring the instrument panel of a B206S twin-engined six to eight seater executive aircraft, manufactured by Beagle Aircraft, England. The fiftieth of this series will shortly be delivered to the Australian Royal Flying Doctor Service. The plane has 221 cubic feet of cabin space. It is claimed to have all-weather capability, a range of 1,500 miles, and a cruising speed of about 222 m.p.h.

foster hi-fi speakers

High Compliance tweeters

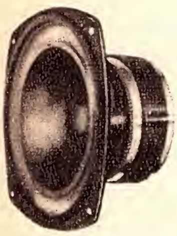
FT-502

SPECIFICATIONS·
Size: 50 mm (2 in.)
†Impedance: 8 or 16 Ω
Frequency Range: 2,000~20,000 c/s
Sensitivity: 100 dB
Power: 30 W max., 8 W nom.
Dimensions: 82×82 mm, 29 mm depth
Magnet Weight: 193 g (6.81 oz), Ceramic
Weight: 615 g (1⅜ lbs)

Price $8.04.
Plus Sales Tax $1.68.

High Compliance woofers

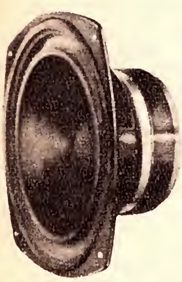
FW-162



SPECIFICATIONS
Size: 160 mm (6½ in.)
*Impedance: 8 or 16 Ω
Resonant Frequency (f_0): 40~50 c/s
Frequency Range: f_0~2,000 c/s
Sensitivity: 97 dB
Power: 30 W max., 10 W nom.
Dimensions: 166×166 mm
81.6 mm depth
Magnet Weight: 500 g (1⅛ lbs), Ceramic
Weight: 1,660 g (3¹¹⁄₁₆ lbs)

Price $12.00.
Plus Sales Tax $2.50.

FW-202

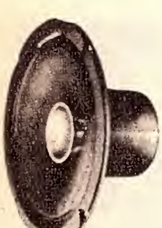


SPECIFICATIONS
Size: 200 mm (8 in.)
*Impedance: 8 or 16 Ω
Resonant Frequency (f_0): 30~40 c/s
Frequency Range: f_0~2,000 c/s
Sensitivity: 98 dB
Power: 45 W max., 15 W nom.
Dimensions: 208×208 mm
90.8 mm depth
Magnet Weight: 830 g (1¹³⁄₁₆ lbs), Ceramic
Weight: 2,760 g (6¹⁄₁₆ lbs)

Prices $23.64.
Plus Sales Tax $4.93.

Double-cone speakers

PW-65A



Size: 160 mm (6½ in.)
*Impedance: 8 Ω
Resonant Frequency (f_0): 70~100 c/s
Frequency Range: f_0~15,000 c/s
Sensitivity: 97 dB
Power: 6 W max., 5 W nom.
Dimensions: 164.9 ⌀mm, 86.2 mm depth
Magnet Weight: 77.6 g (2.73 oz)
Weight: 476 g (1¹⁄₁₆ lbs)

Price $6.60.
Plus Sales Tax $1.35.

*at 400 c/s; †at 3,000 c/s

High Compliance wide range speakers

FE-103

Price $8.64.
Plus Sales Tax $1.04.

Size: 100 mm (4 in.)
*Impedance: 8 or 16 Ω
Resonant Frequency (f_0): 65~95 c/s
Frequency Range: f_0~18,000 c/s
Sensitivity: 96 dB
Power: 5 W max., 3 W nom.
Dimensions: 105×105 mm, 46.6 mm depth
Magnet Weight: 193 g (6.81 oz), Ceramic
Weight: 630 g (1⅜ lbs)

FE-163

Price $14.64
Plus Sales T[ax]
$3.05.

Size: 160 mm (6½ in.)
*Impedance: 8 or 16 Ω
Resonant Frequency (f_0): 40~60 c/s
Frequency Range: f_0~20,000 c/s
Sensitivity: 98 dB
Power: 10 W max., 5 W nom.
Dimensions: 166×166 mm, 73.7 mm depth
Magnet Weight: 398 g (14.04 oz), Ceramic
Weight: 1,260 g (2¾ lbs)

Coaxial speakers

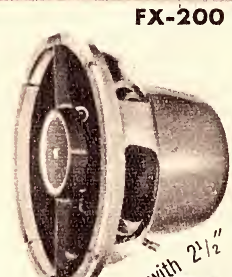
FX-201

with horn tweeter

Prices $23.88.
Plus Sales Tax $4.98.

Size: 200 mm (8 in.)
*Impedance: 16 Ω
Resonant Frequency (f_0): 45~75 c/s
Frequency Range: f_0~18,000 c/s
Sensitivity: 101 dB
Power: 10 W max., 5 W nom.
Dimensions: 206 ⌀mm, 137.5 mm depth
Magnet Weight: 240 g (8.46 oz)
Weight: 2,200 g (4⅞ lbs)

FX-200 G2



with 2½" tweeter

Price $21.60.
Plus Sales Tax
$4.50.

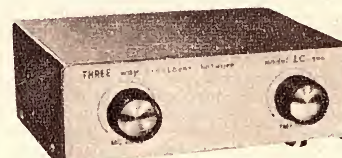
Size: 200 mm (8 in.)
*Impedance: 16 Ω
Resonant Frequency (f_0): 45~75 c/s
Frequency Range: f_0~18,000 c/s
Sensitivity: 101 dB
Power: 10 W max., 5 W nom.
Dimensions: 206 ⌀mm, 140.7 mm depth
Magnet Weight: 234 g (8.21 oz)
Weight: 2,200 g (4⅞ lbs)

2-way network

LC-100
Price $6.60.
Plus Sales Tax
$1.38.

Crossover Freq.: 2,500 or 3,500 c/s
Impedance: 16 Ω
Attenuation: 6 dB/oct.
Dimensions: 63.1 ⌀mm, 69 mm height
Weight: 280 g (9.88 oz)

2 or 3-way network



LC-300

Crossover Freq.: 350 or 700 c/s, 2,500 or 5,000 c/s
Impedance: 8 or 16 Ω
Attenuation: 6 dB/oct.
Dimensions: 83 H×200 W×134 mm D
Weight: 1,430 g (3⅛ lbs)

Price $22.20.
Plus Sales Tax $4.63.

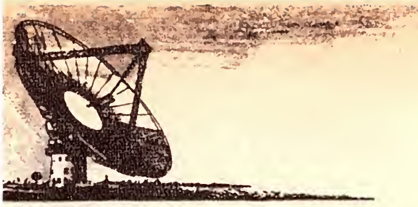
tweeter

FHT-1

FHT-1
Price $11.04.
Plus Sales Tax $2.30.

†Impedance: 16 Ω
Frequency Range: 2,500~16,000 c/s
Sensitivity: 100 dB
Power: 10 W max., 5 W nom.
Dimensions: 110 mm height, 95 mm depth
Weight: 330 g (11.75 oz)

(SOLE AGENT) ZEPHYR PRODUCTS PTY. LTD.
70 BATESFORD ROAD, CHADSTONE, VICTORIA



lm of cadmium sulphide is "grown" in an evaporating plant. eated cadmium sulphide at the bottom of the evaporating hamber is evaporated upwards and a stream of atoms is eposited on the glass slide within a heated chimney. To btain the shape of film required, the atoms are evaporated hrough a mask cut to the required shape. The main problem p till now has been to deposit a perfect film on the slide — a roblem which resolves largely as one of temperature control — ut recently the Edinburgh team has perfected a process which vercomes this problem.

The DOFIC process is one of the more recent developments the study of bulk semiconductor mechanisms, and as such closely related to the techniques associated with the Gunn ffect.

Colour TV standards converter

A significant technological breakthrough has been achieved y B. B.C. engineers with the invention of a system for converng colour television signals from the American 525-line, 60-eld standards to the British and European 625-line, 50-field andards. The B.B.C. has been concentrating considerable effort n this problem in an attempt to devise a system which will low direct exchange of programs between countries using either f these standards, particularly since the rather simpler systems reviously used for black and white program conversions was ot suitable for use with colour television. The Corporation as particularly keen to be in a position to make direct lecasts via satellite from the Olympic Games in Mexico next ear. Now the early solution of the problem allows the B.B.C. o participate in trans-Atlantic exchange programs from the inception of its colour service.

The problem of differing line standards on black and white levision had previously been solved in 1963, when the B.B.C. eveloped the first all-electronic converter, now in use throughout urope. This allows programs originating on systems using the 25-line, 50-field standards to be converted for transmission ver the B.B.C.-1 network, which uses 405-line, 50-field standards. he problem is greater when converting from American standards, ecause the differences are not only in the line standards ut also in the field standards.

The optical methods of conversion previously used for 50 to 0 field conversion gave rise to picture degradation. While the degree of degradation was not regarded as serious for black and white television, it was of a quite unacceptable order for colour television. The new all-electronic converter does not suffer from the defects of the optical system.

SEACOM installation

World-wide subscriber-to-subscriber dialling became more of a possibility with the opening of the SEACOM cable link with South-East Asia. The equipment installed in Sydney to meet the requirements of the SEACOM cable is an extension of the Intercontinental Telephone Exchange supplied by the Plessey Telecommunications Group for the COMPAC cable in 1963.

The equipment allows trunk operators throughout Australia to dial direct via the cable to other parts of the world. Only one manual operation is involved, a single dialling by the international operator originating the call.

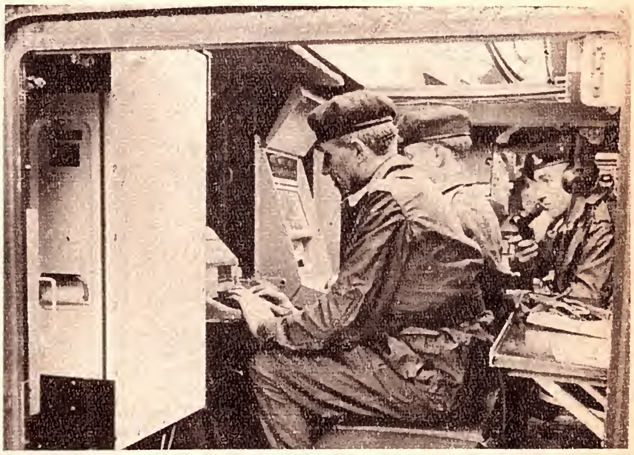
Post-graduate training

A post-graduate course in process control is to be arranged by the Sydney University Chemical Engineering Association, on behalf of the university's Chemical Engineering Department. This will be a full-time course of one week's duration, from August 28 to September 1, consisting of intensive study in process control, ranging from fundamentals of systems analysis to the latest techniques employing digital and analogue computers. The course will include lectures, demonstrations, and tutorials. An enrolment fee of $50 is payable, and a full set of lecture notes will be provided at no extra cost. Further details may be obtained from the Secretary, Department of Chemical Engineering, University of Sydney.

Marconidata for Czechoslovakia

The Ministry of Transport (Railways Research Department) in Czechoslovakia, has bought a Marconidata type H6010 data transmission system from the Marconi Company, of England, to be used in the course of a complete evaluation of the use of the telephone network for data transmission. The type H6010 is a new addition to the Marconidata range of medium-speed data transmission equipment. By making a simple telephone call, an operator can transfer information from punched paper tape into a computer simply by pressing a button on the transmitting Marconidata terminal. No manual intervention is necessary at the receiving end.

Data can be transmitted at up to 50,000 characters per second, more than ten times faster than with a conventional telegraph or teleprinter circuit, and with a very high degree of protection from errors caused by noise and interference on the telephone curcuits. Less than one character in ten million will be transmitted incorrectly — roughly equivalent to printing the entire works of Shakespeare twice, with only one letter in error.



Seventy-six micro-electric computer systems, known as Field Artillery Computer Equipment (FACE), for front-line use by the Royal Artillery have been ordered from Elliot Space and Weapon Automation Ltd., England. The computer on which the system is based is in the left foreground of the view (above) inside a mobile command post in a tracked and armour-plated vehicle. Numerical data of target locations and meteorological information is put into the keyboard console of the equipment by an operator (left). The computer will calculate the range, bearing and angle of target, changes in weather data, the effect of gravity on shell flight, and correction for non-standard ammunition, all within the space of 12 seconds.

ore computers for Uni.

A new large computer complex has been talled in the Basser Computing Department of the School of Physics, University Sydney. It consists of an IBM 7040 upled to an IBM 1401, and is the largest installed by the Department. It will be d to train undergraduates in computer plications. Post graduate students will be e to use the computer for research prots. The addition of these computers to se already available in the Basser Comting Department will greatly increase the mber of student and research jobs the partment can handle each day.

The fast throughput of many different s on the IBM computers is largely due the "IBSYS Monitor System" with which two computers are equipped. This is program, or a series of instrucns, which controls a continuous stream jobs in different computer languages to n on the machines without interruption. The computer itself is a scientific/comrcial machine, linked under control of "Monitor" program. The central procesg unit of 7040 is suitable mainly for fast ndling of lengthy calculations; the 1401 the other hand edits and co-ordinates ding of alphabetic and numerical data o the system. Magnetic tapes can be ndled by either processor.

omputer training for boys

An ambitious program of instruction, signed to provide every one of its boy dents with a basic knowledge of comer operation and programming, has been cessfully inaugurated at a high school Connecticut, U.S.A. To initiate the prom, the school has installed a PDP-8 entific digital computer supplied by Digital uipment Corporation, Maynard, Massasetts (the U.S. principals of Digital uipment Australia Pty. Ltd., 89 Berry eet, North Sydney).

For the initial training program, 34 dents were selected, whose qualifications nsisted of two years science and one year algebra and geometry. A week was en out of the normal teaching schedule l used to instruct the boys on computer ndamentals, programming techniques and rtran computer language. At the end of s time, the students were given a qualifyassignment. This consisted of writing program to find the values of X in the adratic equation

$$AX^2 + BX + C = 0$$

all values of A, B and C. Within two eks, 28 of the 34 students had a work- program.

Using the approach developed on the t group, over 90 per cent of the school s given a short computer course, adjusted to the level of mathematical maturity of each group of students. Assignments, to be carried out on the computer, were given to all the science and mathematics classes. These assignments were problems that the teachers would normally have hesitated to use, because of the amount of time required.

With the program successfully initiated, boys are now working on programs dealing with topics such as electronic circuit analysis; a new triple precision floating point arithmetic package; and refraction of light in the atmosphere. Some of the boys are programming using MACRO-8, the PDP-8's symbolic assembly language. They are also using a desk-calculator simulator program called "Calculator" to do their homework and laboratory calculations.

Portable security system

Securiton Ltd., of Worcester Park, England, has added a new solid state portable alarm to its range of security systems. The system, designated "Bleep," comprises a lightweight transmitter housed in an unbreakable case and a receiver which accepts a coded message from the transmitter over a special radio link. The signal is released by a pushbutton switch on the transmitter. Upon receipt of the signal from the transmitter, the receiver actuates warning signals such as bells or a telephone call to police. Any number of "Bleep" transmitters can operate in close proximity since each uses a different coded frequency signal.

The transmitter is housed in a pocket sized case (2½in x 3⅞in x 1in) with the aerial integrated in the case. It operates on a mercury cell which will give power under normal use for more than one year. The receiver is powered by an external supply which normally comes from the batteries of a security control unit. The integral coding system protects completely against receiving a signal from sources other than its own transmitter, and it is impervious to any local interference such as electrical discharge, motors, etc.

Semiconductor patents

Patents covering two manufacturing techniques that counteract surface and bulk defects in semiconductor devices have been awarded to Motorola Inc. based on research work at the company's Semiconductor Products Division here.

Patent No. 3,302,076 "Semiconductor Device with Passivated Junction," relates to an improved design for passivated diodes and transistors whereby the electrode configuration for contacting the various conductivity regions of such devices acts to improve their surface states. It covers an invention commonly referred to as "field relief electrode" or "equipotential ring" technology.

This was followed by two patents on the annular process for manufacturing semiconductors, bringing to 54 the total number of semiconductor patents issued to Motorola within the past two years.

The issuance of these recent patents on the annular process and field relief electrodes is noteworthy because the two technologies are often merged for complementary effects. Field relief electrode and annular developments serve complementary roles in device manufacture by controlling surface and bulk defects.

Field relief electrodes are used broadly in the manufacture of semiconductor devices that have been manufactured with a protective, passivating oxide film over critical surfaces. Without the electrodes, unwanted surface states can have an unfavourable effect on the electrical characteristics of the devices particularly if they are not annular in structure.

Contamination and other effects of passivated surfaces can alter the resistivity and nature of the semiconductor material regions near the oxide-semiconductor interface, especially adjacent to the junctions. The use of field relief electrodes helps to eliminate this problem and consequently improves product performance and reliability.

Major Mexican orders for telecommunications equipment have been won by Standard Telephones and Cables Pty. Ltd., against worldwide competition. The microwave radio-link equipment has been bought by Telephonos de Mexico principally to accommodate the increased tourist traffic and also as a preparation for next year's Olympic Games. It is the second big Mexican order awarded to STC. Last year, the company won an order for radio-link equipment valued at over $300,000. The dotted lines on this map of Mexico indicate the routes of telephone links covered by orders received by STC. The latest contract is for the Mexico City-Acapulco and Monterrey-Nuevo Laredo links.

Call for papers

The next triennial congress of the International Federation for Information Processing — IFIP Congress 68—will be held in Edinburgh, Scotland, from August 5 to 10, 1968. In addition to invited papers reviewing various aspects of computing, a large part of the program will be devoted to submitted papers. These will cover computer applications, hardware, software, and mathematics. An appeal for papers has been made and full details of the procedure for submitting papers can be obtained from IFIP Congress Office, 23 Dorset Square, London N.W.1, England.

NEW PRESIDENT FOR I.R.E.E.

Professor R. M. Huey has been elected President of Institution of Radio and Electronics Engineers, in cession to Mr A. de Courcy Browne. Professor Huey Associate Professor of Electrical Engineering at the niversity of N.S.W. and has recently been appointed to biennial vacancy on the council of the University as presentative of the Faculty of Engineering. He has been senior member of the I.R.E.E. since 1963 and has served iously on the Publications, Qualifications and Education ards of the Council. He is also a member of the National mmittee for Scientific Radio of the Australian Academy Science, and is Australian correspondent for Comssion VI of the International Union for Scientific Radio.

›lour TV course

'he Division of Post-Graduate Studies in University of New South Wales will ›ent a series of ten radio lectures design- to give an introduction to the principles techniques of colour television. The ures will be broadcast weekly over Radio versity VL2UV, Newcastle, commenc- in August, 1967. The course covers the damentals of the NTSC, SECAM and L systems, the principles of colorimetry the chromaticity diagram, the nature :hrominance signals, coding transmission. : course will also deal with colour ıeras, colour receivers, and testing and up procedures for colour systems.

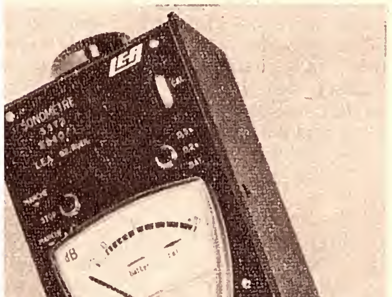
'he fee for the course is $6, which may tax deductible. This covers the supply the printed notes, which are essential an understanding of the lectures. Clos- day for enrolments is 14th July, 1967.

'urther information on this course and er Radio University programs can be ained from Radio University, P.O. Box Censington, Sydney.

›nique recorder

nexpensive, highly precise X-Y recorders ıg 8½ x 11in chart paper, held in place permanent magnetism, are now available n the Varian Recorder Division, 611 ısen Way, Palo Alto, California 94303. ›ignated the Series F-100, these rugged table-top recorders are highly accurate .25 per cent of full scale — and have ıter range sensitivity (100 microvolts/ ı) than earlier models. Slewing speed Hz) is 15in/second, and repeatability is 3 per cent of full scale.

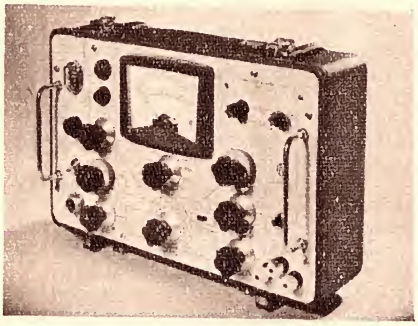
Jnique with this recorder is the method ıolding down the chart paper. The platen ı magnet-impregnated hard rubber pad, the paper is printed on one side with a magnetic ink pattern. Attraction between the two firmly maintains paper alignment and eliminates the need for electrostatic or vacuum hold-down devices commonly used on X-Y recorders. The paper position on the platen can be easily adjusted. No electronics are used for paper hold-down; thus, it is "fail-safe," requires no power, and is always "on."



This compact sound level meter, manufactured by Laboratoire Electro-Acoustique of France, is designed to simulate an average human ear and to provide objective measurements of sound or complex noise levels within a range extending from close to the audibility threshold to above the pain threshold.

First BC station in Qatar

Qatar, one of the wealthy oil States in the Arabian Gulf, is to establish its first broadcasting station. The project was put to international tender and won by The Marconi Company, who have already started to supply the equipment. A 100KW short-wave transmitter will be used to provide coverage over a 1,200 miles radius and will be supplemented by a 10KW medium wave transmitter for local broadcasting. Both transmitters, broadcasting identical programs, will be installed in a station a few miles outside Doha, the capital of Qatar, and will be connected to a studio in Doha itself. Marconi's anticipate that they will have the project completed in time for transmissions to begin early in 1968.



A new instrument, Type TT537, manufactured by Avo Ltd., Dover, England, determines the characteristics of transistors and diodes. It measures transistor hfe up to 1500 at a frequency of 1KHz. Also leakage current, starting at 1uA, for PNP and NPN, low and medium power, germanium and silicon transistors. The collector voltage can be varied continuously up to 12V. Collector current is measured in 10 ranges from 1uA to 1A. The reverse characteristic of diodes can be determined up to 1000V, the current being automatically limited. The forward characteristic is measured at 1.5 or 5V with a maximum current of 500mA.

Computerised water supply

For the past three years Britain's Water Research Association has been solving water distribution network problems for member authorities by using a British Aircraft Corporation Analogue Computer installed in the Association's physics department. The Birmingham City Council's Water Department have now taken a lead by placing an order for one of these computers for use in the first regional centre, at which the distribution networks of Birmingham and neighbouring authorities will be studied.

The BAC Analogue Computer provides an electronic "carbon copy" simulation of the actual water network, in which flow and pressures are read out in the units used by the Distribution Engineer. In this way, the experience of the engineers can be applied directly to the "carbon copy" model without the need for translation into special programs or "computer language."

This method of computation is rapidly gaining favour and water engineers from many overseas authorities are now going to the U.K. to study their networks on the BAC Water Network Analogue.

Factors in the design of an FET Voltmeter

At first sight, design seems likely to involve little more than modification of the usual VTVM circuit. But it isn't that simple . . .

by Jamieson Rowe

Over the years the familiar "vacuum-tube voltmeter" or VTVM has become firmly established in electronics workshop and laboratory situations as the preferred instrument for making circuit voltage measurements. With an input impedance usually of the order of 10-megohms shunted by a few picofarads it causes little if any disturbance to the circuit under test, and is thus able to make valid and unambiguous measurements in places where other instruments would either upset circuit operation entirely or at least produce dubious readings.

In the majority of workshop and laboratory situations the usual VTVM has few limitations; however it has two characteristics which make it somewhat unsuited for use in "field" situations. The first of these is that it is almost invariably a mains-powered instrument, and cannot easily be taken to places remote from the power mains. The second characteristic is that it usually employs the thermionic valves in a DC amplifier circuit which commonly takes of the order of 5-10 minutes to stabilise after switch-on.

A battery-powered VTVM would probably be feasible, but would tend to be somewhat more complex than the mains type if reliability and accuracy were to be maintained. It would also tend to be rather inefficient, in common with other thermionic valve equipment operated from batteries, and would accordingly require quite frequent battery replacement.

In any case, the use of a battery power supply would not obviate the warm-up problem, and this alone would detract from the usefulness of such an instrument in many "field" situations.

For some time now it has been possible to construct a "solid state" equivalent of the VTVM using junction transistors. However such instruments again tend to be rather complex if reliability and accuracy are to be maintained, both because junction transistors are inherently low input impedance devices and also because there are problems with leakage currents and their temperature dependence.

It is true that there are fewer proble in this regard with silicon transist than with the germanium variety, a that with suitably chosen devices it possible to produce quite a satisfactc design. However, the complexity a cost tend to be rather high, so that t appeal of such an instrument is large in terms of the design exercise.

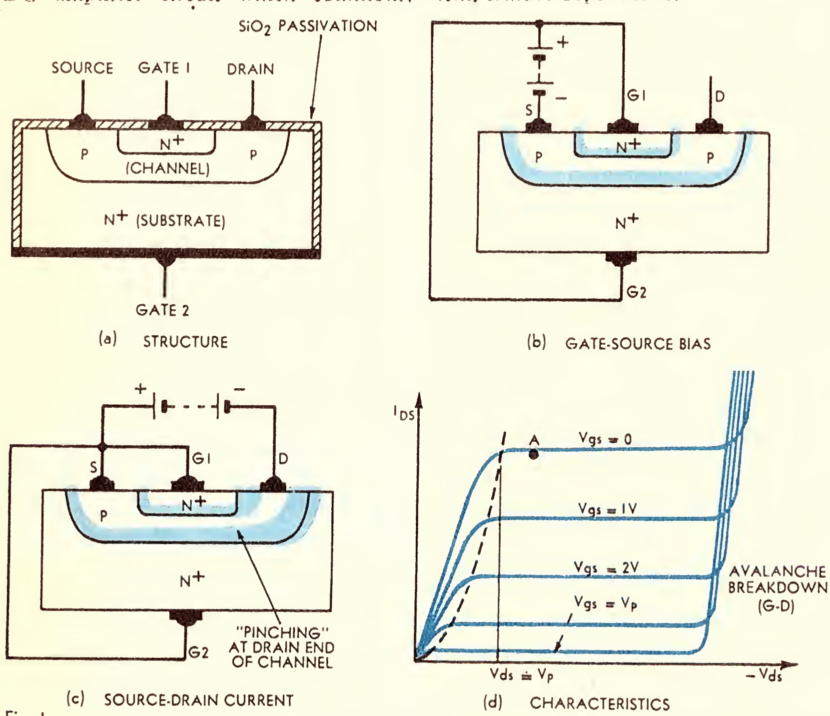
Whereas germanium and silic junction transistors are inherently rath unsuitable for use in this type circuit, the recently developed fiel effect transistor or "FET" is in theo quite well suited. It is a voltag controlled device, in contrast with t current-controlled junction transist and, in addit.on, it has the very hi inherent input resistance of a revers biased P-N junction rather than t low resistance of a forward-biase junction. (We are talking here the junction FET or "JFET" rath than the insulated-gate IGFET or tl metal-oxide-semi conductor MOSFE but these have even higher input r sistance than the JFET.)

In principle the FET seems so we suited for use in an electronic vol meter that, at first sight, one is tempte to assume that development wou consist of little more than substitutic of the new devices for the thermion valves in a standard VTVM circui Evidence that this is a common assum tion has been provided by a number c letters and telephone calls from reade in the period since economy JFET were released here some six month ago.

Unfortunately there is rather more t the design of an FET voltmeter than on might think from an initial considera tion and, in this article, the author wi attempt to explain some of the factor involved. It is hoped that this wi allow readers to understand why, as yet **Electronics Australia** has not been abl to publish an economically practica design.

While the discussion will be mainl in general terms, some practical circui details will be given. However, it shoulc be emphasised at the outset that thi information is intended only for experi ment by those interested and shoulc not be taken as the basis for a regula constructional project.

It will probably be worthwhile tc begin with a brief description of the JFET and its operation, both as ar introduction to the device for those ye unacquainted with it and as a recapitu lation for those not in this position Readers who find the description giver here too cursory are referred to a more



The structure of a double diffused P-channel JFET, together with diagrams used to explain its operation and a graph of the drain voltage-drain current characteristics.

:tailed treatment which was published ı the February 1967 issue (pp. 85-87).

The operation of the JFET is quite ıfferent from that of the normal junc- on transistor. Basically it involves the ›ntrol or modulation of the conduc- ınce of a relatively narrow strip of :miconductor material called the **chan- :l** by a transverse electric field asso- ated with an adjacent electrode called **ıe gate.**

Figure 1(a) shows the basic structure : a P-channel double diffused JFET, hich is the type of device currently /ailable at low cost. As may be seen consists of a lightly doped (therefore ›w conductivity) P-type channel with :avily doped (and therefore high con- ıctivity) N-type gate regions either side : the narrow section. The ends of the ıannel are normally called the "source" ıd "drain," while the two N-type :gions are normally tied together and mply called the "gate."

In general terms the device operation :pends upon the gate-channel P-N nctions being reverse-biased so that :pletion regions extend into the lower ›nductivity channel and, by exclusion, ›ntrol the portion of the channel avail- ›le to pass current between the source ıd gate. More specifically, there are /o independent but complementary ıenomena involved, and these are illus- ated by the diagrams of figures 1(b) ıd 1(c).

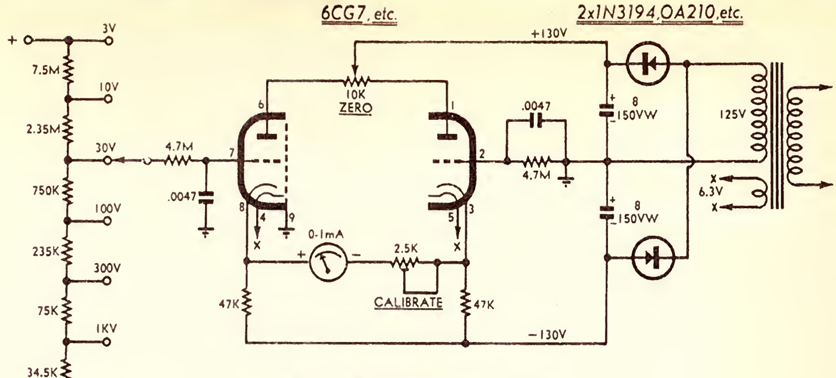
If a fixed external bias is applied :tween gate and channel as in (b), the :pletion regions extend evenly through- ıt the channel. In contrast, if the gate tied externally to the source and ›urce-drain current allowed to flow as (c), the ohmic voltage drop set up the channel produces a progressive **ternal** reverse-biasing of the junctions, ıusing the depletion regions to extend ıevenly and "pinch" the narrow chan- :l at the drain end.

In normal operation both mechanisms ›erate to produce a family of Ids-Vds ırves, as shown in figure 1(d). For any ven external gate-source bias Vgs the ·ain current first increases rapidly, then :aches a "knee" after which it increases ıly with substantial increase in Vds.

The "knee" of each curve corresponds ı an equilibrium between the channel ırrent flowing and the "pinching" of ıe channel which tends to reduce ırrent. As the fixed bias Vgs is in- :eased, the "knee" occurs at lower and ›wer drain voltages and currents, as ıown by the dashed parabolic curve. heory shows that this curve corresponds the locus of points where the **drain- ıte voltage Vdg** is equal to a value p, termed the "pinch-off" voltage. Thus hen there is zero external gate bias /gs = 0) the "knee" occurs at ds = Vp; while if the external gate as is raised to equal Vp (Vgs = Vp), e device is effectively **cut off** because ıe pinch-off equilibrium is present even :fore drain current flows.

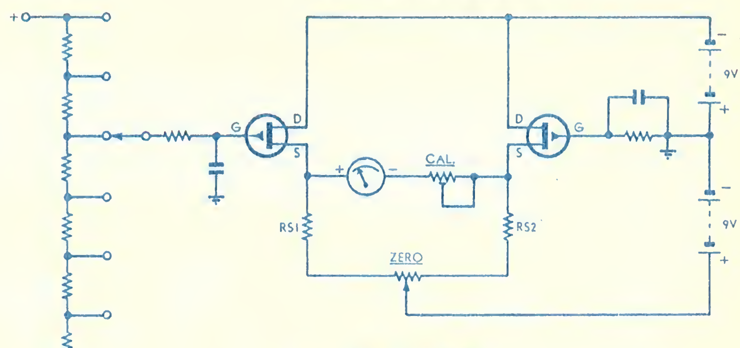
The region of the characteristic curves ı the left of the dashed parabola is ›rmally called the region of "triode" ›eration, while that to the right is ılled the "pentode" region. In both ıses the terms used draw attention to milarities between the section of the ıaracteristics concerned and those of ıe appropriate thermionic valve type.

The JFET is normally operated in the ›entode" region as it is here that the



BASIC ELECTRONIC VOLTMETER USING THERMIONIC VALVES

Fig. 2



JFET VOLTMETER —INITIAL CONFIGURATION

Fig. 3

At the top is the basic circuit of a modern electronic voltmeter using thermionic valves. Beneath it is a basic JFET voltmeter circuit derived from the valve circuit, used as a starting point for the discussion.

device is capable of the highest order of linear amplification.

Having briefly introduced the JFET and its operation, let us now consider how the device may be used in an electronic voltmeter.

Figure 2 shows the basic DC voltage measuring circuit of a modern thermionic valve voltmeter. As may be seen it consists essentially of a pair of cathode followers having the meter connected between their cathodes. The follower on the left is used as an impedance transformer coupling the input signal to the meter, while the follower on the right is used to maintain the negative side of the meter at a voltage level equal to that of the left-hand cathode with zero input. The right-hand follower may be regarded as a voltage divider whose division ratio and temperature coefficient are closely matched to those of the input follower.

The 10K pot in the plate circuit is used to adjust for exact balance between the two followers. The action of the pot is thus that of a "zero" adjustment.

As the input cathode follower has an extremely high input resistance a simple voltage divider may be used to perform range multiplication, the total divider resistance being set at about 11M so that the loading effect of the instrument will be slight.

As a small amount of grid current is inevitable even with modern valves it is necessary to maintain an approximate correspondence between the resistance in the grid circuits of the two cathode followers if the balance between the two is to be maintained despite range switching. This is the purpose of the 4.7M resistors in each grid circuit.

The power supply to the followers is arranged so that, for zero input, both grids are at a potential midway between the positive and negative supply rails. This ensures that the quiescent voltage drop of the valves is approximately equal to that of the cathode load resistors, a condition which tends to give the greatest available dynamic range and hence the highest linearity.

From a preliminary appraisal of the JFET and using the design philosophy behind the valve circuit as a guide, one is led fairly naturally to propose the circuit of figure 3 as the starting point for a JFET version.

As may be seen this involves little more that the substitution of a pair of JFETs for the original double triode, and twin 9V batteries for the original centre-tapped power supply. The circuit now becomes a twin "source-follower."

The only other change is that the zero balance control has been placed in the source circuit rather than in the drain circuit. The reason for this is that from a consideration of the pentode-like JFET characteristics one would expect that a control in the drain circuit would have only a second-order effect upon the JFET currents. In contrast a control in the source circuit seems likely to be somewhat more effective, in that it will give differential control over the self-bias developed by the devices in their source resistors.

Note that series gate resistors have been shown, corresponding to the resistors used in the valve circuit to maintain approximate zero balance despite gas current. The reason for retaining these resistors in the JFET circuit is that these devices have an effective equivalent to

gas current in **Igss**, the leakage current of the gate-channel junctions.

Probably the most effective way of showing up any "first-order" problems which may be involved in a circuit is to attempt to set its quiescent operating conditions. Accordingly, having accepted the circuit of figure 3 as a likely starting point, our most profitable next move will be to consult the JFET data sheets with the intention of arriving at the appropriate circuit constants.

Reference to the data sheets of cur-rently available devices reveals almost immediately an important complication regarding their circuit behaviour and its prediction. The complication is that JFET parameters, like those of other semiconductor devices, are subject to appreciable **production spreads.**

It is probably true to say that currently available JFETs are, as a class, subject to somewhat wider spreads than other commonly used devices. Whether this is true or not, however, it is inevitably the case that the JFETs with the widest parameter spreads are the very devices which originally prompted the present article—the recently released "economy" devices.

A good idea of the extent of the spreads associated with economy JFETs may be gained by reference to the 2N4360 device, which we have used in a number of recent **Electronics Australia** projects. From an economy view-point this device is particularly attractive in view of its unit cost of $1.05 in small quantities.

A parameter which plays a major part in determining the DC circuit behaviour of a JFET is **Idss**, the drain-source current with **zero** gate-source bias and a specified drain-source supply voltage. On the curve of figure 1(d) Idss corresponds to the drain current at a point A on the Vgs = 0 curve; as may be seen it effectively determines the absolute scaling of the vertical (Id) axis.

With the 2N4360 device this parameter has a spread covering a full decade in current values — the maximum specified value is 3mA, while the maximum is 30mA.

The second main DC parameter of the JFET is **Vp**, the nominal pinch-off voltage. This is defined in a number of ways, the simplest being that it is the reverse gate-source voltage necessary at a specified drain-source supply voltage to reduce the drain-source current to a very low (effectively zero) value. Because of the control characteristic of the JFET this parameter is closely related to the transconductance of the device, as will be shown shortly.

The spread in Vp for the 2N4360 device is not fully specified by the manufacturer, who quotes only a nominal value of 5.5V and a maximum of 10V. However from a consideration of the transconductance figures given one can make a fair estimate of the minimum Vp, and this works out to be a little below 1V. Hence parameter Vp also has something like a full decade of spread variation.

Probably the most immediate implication of the wide spread in JFET parameters is that the family of Ids-Vds curves of figure 1 (d) becomes of little use for design, or at least for the purpose of setting up DC operating conditions. Because of the wide spread in both Idss and Vp, there will be virtually a whole "family of families" describing the possible Ids-Vds characteristics of the device; and because Idss and Vp are independent within certain limits, the number of "member families" will be extremely large.

The result is that we are forced to seek a more concise method of presenting the JFET behaviour, and one which is capable of showing the performance of all individual devices within the spread limits. A characteristic which satisfies these requirements is the Ids-Vgs "transfer" characteristic, which corresponds to the Ip-Vg curve of a thermionic valve.

it represents the transconductance. As the slope is greatest at the point where Ids=Idss, this shows that the JFET has highest gain when zero bias is applied.

It is this maximum value for transconductance (gm) which is usually quoted by the manufacturer, either as such or as the closely equivalent parameter Yfs — the forward **transadmittance** at a specified signal frequency (usually 1KHz).

If we substitute Idss for Id in equation (1) and differentiate we get an expression representing the **maximum** transconductance. This turns out to be approximately

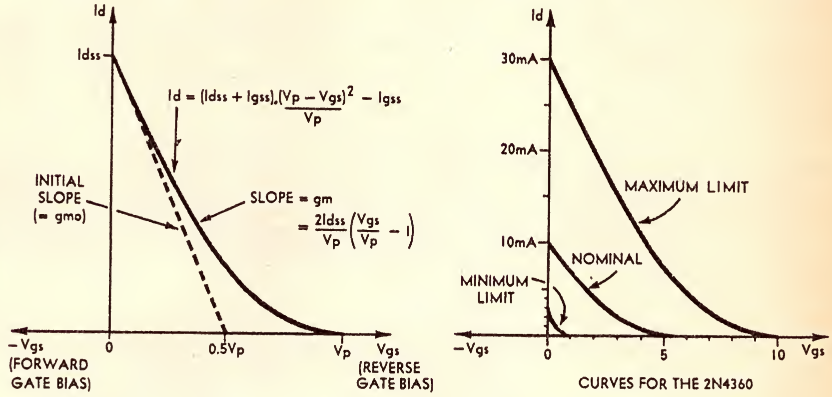


Fig. 4 (a) (b)

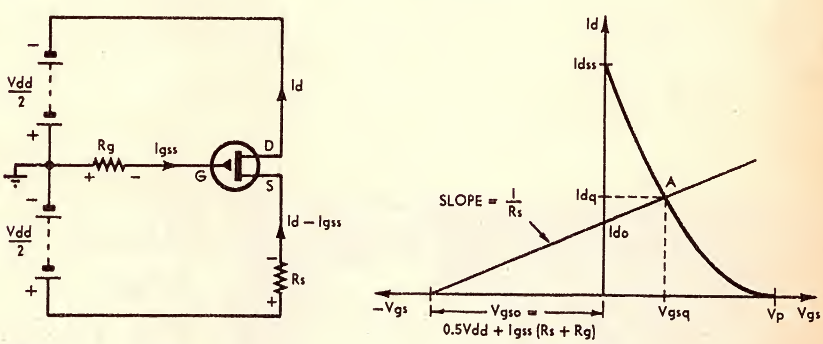


Fig. 5 (a) (b)

More specifically, as we are usually only interested in operating the JFET in the pentode region, we are accordingly interested only in its Ids-Vgs characteristic for this region. And it so happens that within this region of operation the transfer characteristics of the JFET can be deduced fairly easily from the data provided by the manufacturer.

Most JFETs currently available, including the 2N4360, are fabricated by a diffusion process. For such devices the transfer characteristic very closely approximates a parabola, whose equation is

$$Ids = (Idss + Igss).\left(\frac{Vp - Vgs}{Vp}\right)^2 - Igss \quad \ldots (1)$$

Substitution of Vgs=0 into this equation shows that the characteristic crosses the vertical Id axis at a height corresponding to Idss. Similarly the point where it asymptotically meets the horizontal axis is found by substituting Ids=0, and this turns out to be where Vgs=Vp. Between these two points Ids varies closely as the square of the difference between Vgs and Vp.

The instantaneous slope of the transfer characteristic is a measure of the relation between Ids and Vgs — i.e.,

$$gmo = \frac{-2.Idss}{Vp} \quad \ldots (2)$$

From this it can be seen how closely the performance of the JFET is dependent upon the two parameters Idss and Vp.

Put into words, the implication of expression (2) is that the tangent to the transfer characteristic at Id=Idss intersects the horizontal axis at Vp/2. This is indicated by the dashed line in figure 4(a), which also shows the other general properties of the JFET characteristics.

By rearranging expression (2) we can use it to find the Vp of a device, given its Idss and its maximum gm. Hence in the case of the 2N4360, for which no minimum limit is quoted for Vp, we can obtain a close estimate by dividing twice the quoted **minimum** value of Idss (3mA) by the quoted **maximum** value of gmo (8mA/V). This gives a lower limit for Vp of 0.75V.

Similarly if the manufacturer had not supplied a maximum limit value for Vp we could obtain a close estimate again, this time by dividing twice the maximum value of Idss (30mA) by the quoted minimum value of gmo (2mA/V). This would give a maximum

› of 30V whereas, in fact, the maxi-
ım Vp is quoted as 10V — which
ggests that devices which combine a
gh Idss with a low gain are rejected
om the production yield.

We have now reached a point where
can draw transfer curves for a device
presenting both its nominal behaviour
d the limits of spread variation. This
formation has been drawn for the
I4360 in figure 4(b).

The performance of a nominal or
ogie" device is represented by the
ddle curve, terminating at Idss=
mA and Vp = 5.5V and with a gmo
approximately 4mA/V. The two
naining curves represent the limits of
ead variation about this nominal
ve, which variation may be seen to
quite appreciable.

To see how the transfer characteristic
used to determine the operating point
the source followers in our tentative
ET voltmeter circuit, consider now
circuit of figure 5(a). This represents
basic DC circuit of each follower
the zero input situation.

From this circuit it may be seen
t there are three components of bias
tage applied to the JFET gate-source
ctrodes. These comprise the fixed for-
rd bias Vdd/2, a small additional
ward bias produced by the gate leak-
current Igss flowing in gate resistor
, and finally the reverse bias set up
oss source resistor Rs as a result of
source current (Id—Igss).

Because the third of these components
ounts to negative feedback, the bias
lied to the JFET by the circuit will
be independent of the current drawn
the device. Hence we must take both
parameters of the JFET and the
stants of the circuit simultaneously
account in order to determine the
escent operating conditions.

n effect, what this means is that to
l the JFET operating point we must
e, by one means or another, two
ultaneous equations: one describing
relationship between Vgs and Id
m the "point of view" of the JFET,
the other describing the relation-
between the same quantities from
"point of view" of the circuit. Fairly
iously, the quiescent operating con-
ons will be those (presumably unique)
ditions which satisfy both these
ints of view" at once.

The second or "circuit" relationship
be found fairly easily from a DC
lysis of figure 5(a). From this we
get an expression showing the three
nponents of bias voltage Vgs:

$$s=(Id-Igss).Rs-Igss.Rg-0.5Vdd \quad \ldots(3)$$

Rearranging this, we then arrive at
expression showing drain current Id
a function of Vgs and the circuit
stants:

$$= \frac{Vgs+Igss\ (Rs+Rg)\ +0.5Vdd}{Rs} \quad \ldots(4)$$

We have already noted the first, or
vice" relationship between Id and
; it is the device transfer charac-
stic symbolised by expression (1).
wever, it must be remembered that
expression applies only to the pen-
e region of JFET operation. Hence
ore we can use the expression we
st check that the **gate-drain voltage**
lied to the device exceeds the value
which marks the boundary between
de and pentode operation.

n the present circuit this will be
approximately true providing Vdd/2 is
equal to or greater than Vp for the
device concerned.

Although one might expect that we
could now go ahead and simply solve
expressions (1) and (4), this is not the
case. As a result of the spread in device
parameters we have in these expressions
a larger number of variables than the
two which we seek.

If there were no spread, the terms
Idss, Igss and Vp would be **constants**
for the particular device type concerned;
however, because of spread these terms
are, in fact, **variables.** All we know
from the manufacturer's data is the
nominal value and maximum and mini-
mum limit values of each.

more complex JFET circuits this can be
important because for such circuits ex-
pression (4) will become quite large and
unwieldy, and it may become quite diffi-
cult to make predictions of the limits
by "educated inspection."

With a relatively simple circuit of the
type with which we are at present con-
cerned there exists an alternative method
to the "direct calculation" approach, and
the alternative method is not only more
convenient but in certain respects more
informative. It is a graphical method of
solution, and is illustrated in figure 5
(b).

The rationale of this method is as
follows: Because the gate current Igss
is the reverse-bias saturation-leakage cur-

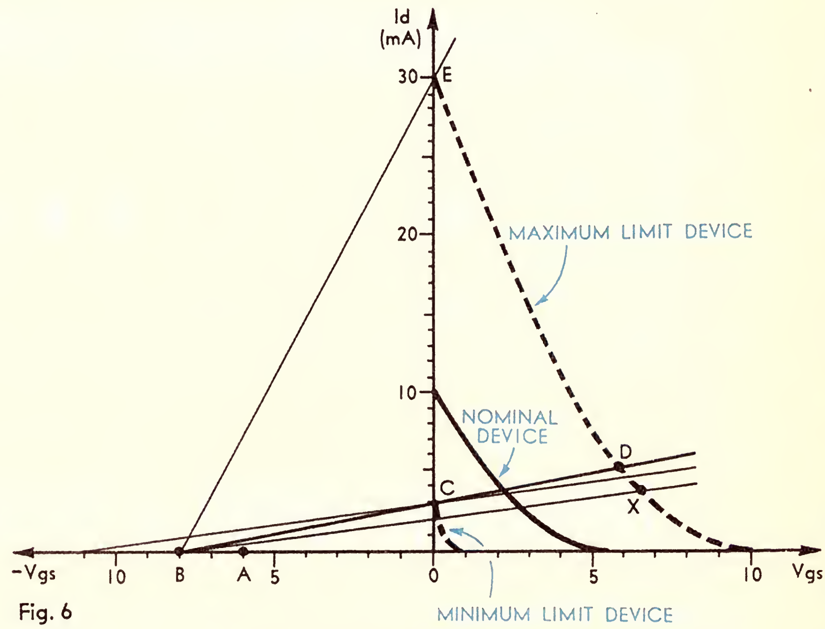


Fig. 6

The problem of remaining within the
region of pentode operation also returns,
because with some devices the criterion
that Vdd/2 be equal to or greater than
Vp may not be satisfied. To satisfy this
requirement for all devices of the given
type it may therefore be necessary to
reduce the fixed gate bias below Vdd/2.

One way of overcoming the main
spread problem is to solve (1) and (4)
three times, substituting for Idss, Igss
and Vp in the first case the nominal
device parameters, and in the second and
third cases those limits of these parame-
ters which by "educated inspection" will
result in the limits of operating point
variation.

As the circuit being considered is a
relatively simple one, expressions (1) and
(4) are sufficiently straightforward to
allow the three solutions to be found in
time-honoured "manual" fashion. Even
so, the results will generally be somewhat
more reliable and more accurate if the
calculation can be performed using a
digital computer.

With JFET circuits significantly more complex than this simple circuit, for this "direct calculation" determination of quiescent operating conditions to be practical at all it becomes virtually essential to use a digital computer to perform the calculations.

Use of a computer has the additional
advantage that the machine can be pro-
grammed to actually **find** the limits of
operating point variation rather than
simply calculate the expected limits. With

rent of the gate-channel P-N junctions,
it is essentially independent of gate-chan-
nel voltage. As a result, two of the three
components of the JFET gate-source bias
voltage may be regarded as constant,
leaving only the feedback component as
a variable.

Both the fixed bias components con-
stitute forward bias, as they tend to make
the JFET gate negative with respect to
the source. Hence from expression (3)
we can theorise that prior to the flow
of channel current in the device, there
will be a forward bias applied between
gate and source whose magnitude will be
given by

$$Vgso=0.5Vdd+Igss\ .\ (Rg+Rs) \quad \ldots(5)$$

In fact, channel current does flow, and,
as a result, the third or "feedback" bias
component appears as a voltage drop
across Rs. This component amounts to
reverse bias, and will have a magnitude
of **Id.Rs.**

Using this information we can draw
on the same axes as our JFET transfer
characteristic a **"bias line"** representing
the relationship between Id and Vgs from
the circuit viewpoint. The line will inter-
sect the horizontal axis (where Id=0)
at a forward bias given by **Vgso** in (5),
and will have a slope of **1/Rs** to describe
the way in which Id must increase in
order to produce the reverse biasing feed-
back voltage.

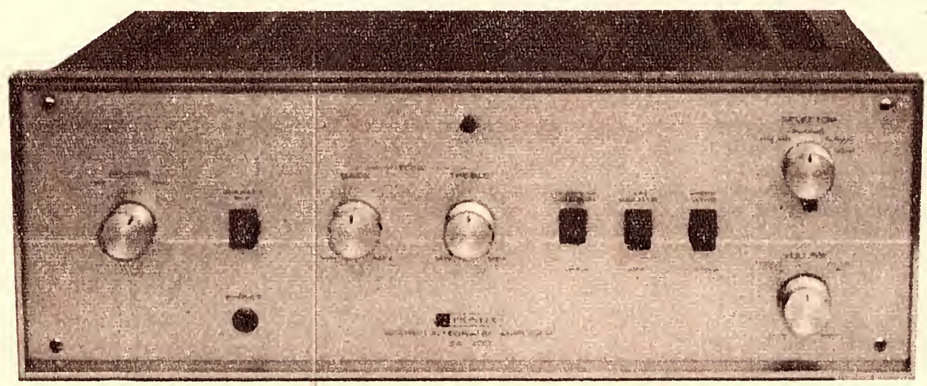
For convenience in drawing the bias
line, the point where it intersects the

PIONEER®

MODEL – SA400

INTEGRATED STEREO AMPLIFIER

Sold only by selected Audio Centres throughout Australia



EXTRA-FINE SOUND AT BUDGET PRICE

TUBES	12Ax7x3; 6BM8x4
DIODES	SD-1Ax2; SE-05-01x2
MUSIC POWER OUTPUT	30 Watts total
POWER OUTPUT	11 Watts per channel (RMS)
HARMONIC DISTORTION	Less than 1% (at rated output)
FREQUENCY RESPONSE	±1DB from 30 to 20,000 CPS
SENSITIVITY (For Rated Output)	Magnetic Phono: 2.3MV Ceramic Phone: 38MV Tape Head: 1.5MV, Tape Line Output Playback (Monitor-in) 150MV Auxiliary: 150MV
TONE CONTROLS	Bass: Boost 12DB, 14.5DB at 50 CPS Treble: Boost 9DB, Cut 11DB at 10,000 CPS

Sole Australian Representative

ASTRONIC IMPORTS

(A division of Electronic Industries Limited)

622 NICHOLSON STREET, NORTH FITZROY, N.Z. (489-1911)

also at

Sydney (31-6721), Brisbane (2-0271), Adelaide (23-4022), Perth (28-3111) and Hobart (2-2711).

ertical axis (Vgs=0) can be found. 'his will be at a current **Ido** given by

$$Ido = \frac{0.5Vdd + Igss \cdot (Rs+Rg)}{Rs} \quad \ldots (6)$$

It should be apparent that in drawing ie bias line on the same axes as the FET transfer characteristic we produce composite diagram which shows both ie "device" and "circuit" relationships etween Id and Vgs. Hence it follows iat in general the intersection of the ias line and the transfer characteristic :presents the quiescent operating point f the circuit, as this point is unique in itisfying simultaneously the device and rcuit relationships.

Thus in figure 5(b) if we have a irticular device whose transfer charac-ristic is as shown by the dashed curve, e may in general conclude that its iiescent operating point will be "A," ith a channel current of Idq and a ite-source voltage of Vgsq.

As with the calculation approach there one important qualification to this ınclusion. This is that the JFET charac-ristic which we are using applies only the pentode region of operation. ence it is important to check that the :vice is actually operating in this region :fore it can safely be concluded that is in fact the operating point.

It was noted earlier that for opera-ın in the pentode region the drain-gate ıltage of the device must be either |ual to or greater than its Vp, and at in the present circuit this is satisfied ıproximately if Vdd/2 exceeds Vp. ore accurately the criterion is given

$$Vdd - Vgso > Vp \quad \ldots (7)$$

In other words, Vdd should be greater an (Vgso + Vp), and this can be as-rtained quite easily from the horizon-l axis of the diagram.

For the purpose of introducing the aphical method of solution we have us far ignored the spread variation in vice parameters. In fact such varia-ıns will mean that in place of the ıgle device transfer characteristic of ure 5(b) we must consider a whole nge of possible characteristics, of hich only the limiting cases are defined.

Hence for a practical circuit using a vice such as the 2N4360 considered rlier the diagram will in fact resemble ure 6. As in figure 4(b) there are now ree curves representing the nominal, iximum and minimum limiting values r the transfer characteristic of the ven device type.

In attempting to use this diagram to sign a practical JFET voltmeter cir-it the first step is to check that all vices will operate in the pentode re-ın of their characteristics. This means effect that expression (7) must be tified even for those devices with the iximum Vp (i.e., 10mA for the J4360).

Both from this point of view and from ıt of linearity it is desirable to use as gh a Vdd as possible. With the type circuit being considered, however, ere is an upper limit on Vdd imposed the device voltage ratings. For the I4360 the ratings dictate that Vdd nnot with safety be increased above V.

Even if Vdd were made 20V, the fixed :ward bias component Vdd/2 alone ıuld only just permit pentode opera-n of all devices. Thus when the

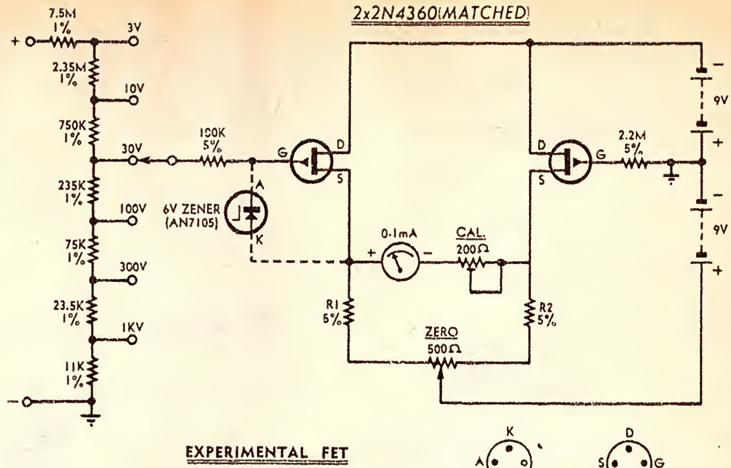


Fig. 7 EXPERIMENTAL FET VOLTMETER

additional bias due to Igss flowing through Rg is taken into account, together with the fact that we originally proposed a centre-taped 18V supply, it can be seen that a centre-tapped supply is just not feasible if the circuit is to operate correctly with all devices.

Note that whereas in some applications it would be permissible to ignore the Igss-Rg component of forward bias, with an electronic voltmeter design this cannot be done. The gate resistor Rg will normally be a direct function of the voltmeter input resistance, and will thus tend to be quite high; not only this but as an instrument the circuit would normally be expected to operate reliably up to moderately high temperatures, where Igss will tend to become appreciable.

In the light of the foregoing it would seem that the most practical supply arrangement would likely be three 6V batteries in series, with the lower junction earthed. This would give a Vdd of 18V and a forward gate bias of 6V, figures which would probably ensure pentode operation of all 2N4360 devices up to about 50 degrees C. and with an input divider arranged to give an equivalent Rg of about 2.5M.

Once Vdd and the fixed forward bias are selected to ensure pentode operation of all devices, the next step is to examine the diagram of figure 6 with a view to selection of a value for t source resistor Rs.

In order that the circuit shall be ca able of operation with all devices of t given type up to a reasonable tempe ture (say, 50 degrees C), no dev should be permitted to adopt operating point where its gate-sou junction is forward biased. Hence if po A on the diagram represents the fix zero-signal forward bias of 6V, and represents the resulting Vgso at 50 grees, the line B-D represents a lov limit on source resistor Rs. It can seen that this line corresponds to an which would cause a minimum lin device to adopt an operating point w Vgs = 0 at the given maximum te perature.

In the present circuit this means t the minimum value which we can choo for Rs is approximately 2.7K.

If the application of the circuit such that signals applied to the JF gate are normally only positive-going, t value of Rs can be made close to t minimum figure. With the voltme circuit being considered this would a practical arrangement; in fact, for go linearity it is desirable because the clo our operating point is to the zero-b situation the closer the working gm the device will approach the maximu value gmo.

On the other hand, with some app cations it may be necessary to provi for inputs being both negat and positive-going. In such cases t values of Rs will have to be increase corresponding to a line such as B- The value would be chosen so that w the value of Vgso increased to corr pond to the maximum negative sig excursion B-X crossed the vertical a at a point no higher than the po Vgs = 0 for the minimum limit devi

It might appear that in settling on value of 2.7K as a suitable source sistor for our JFETs, we have fina arrived at our basic voltmeter circu However, this is unfortunately not t case. In fact, if we look a little clos at figure 6 we will find that to a certa extent our problems have only ju started; it is only now that we are rea in a position to see some of the imp cations of the JFET parameter sprea

Reference back to the proposed circ of figure 3 will show that the me movement will be connected between t two sources. Hence in order that t meter can be zeroed for zero input, will be necessary to arrange that f zero input the two sources can brought to the same potential. Yet we consider the line B-D of figure we see that, for identical source resisto two randomly selected devices are like to have quiescent source voltages diffe ing by as much as 6V or so. For device near the minimum spread lin the operating point will be near "C with the source at approximately ear potential; while a device near the ma mum limit will operate near "D," wi the source at about -6V.

Fairly clearly, we are going to ne to adjust the source resistors individual if any pair of devices are to be operat with identical source voltages for t purpose of zero-setting. And if this to be done while also ensuring that t input transistor operates at maximu gain (i.e., near-zero bias), the tw resistors will need to be adjustable ov a range of about 10:1—from about 2.7

›wn to about 270ohms, the latter rresponding to the line B-E.

It is true that the zeroing control cir-it of figure 3 can be arranged to per-it this range of variation on a differen-.l basis: thus RS1 and RS2 could be ade 270ohms, and the zero pot 2.5K. it further consideration of figure 6 will ow that a differential adjustment will ıt be satisfactory.

The reason for this is that differential justment of the two source resistors ll only permit zero-setting; it will not sure that the input JFET will be

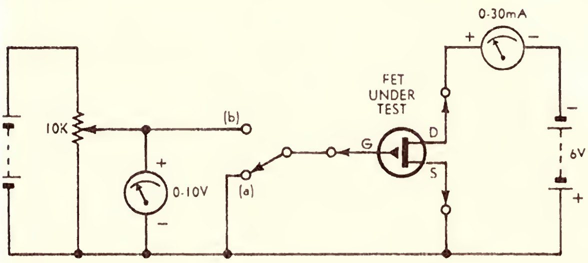


Fig. 8

The test circuit used by the author to select and match JFETs for the experimental voltmeter.

›erating at near-maximum gain. Thus th two devices which are both near e maximum spread limit, zeroing will ıd to cause both devices to operate :ll down their curve, and dynamic nge and linearity will suffer. While th two devices which are both near e minimum spread limit, zeroing will ıd to cause both to draw positive-bias id current; and if this occurs normal haviour will not be possible.

From this one may conclude that the ıly feasible approach would be adjust the two source resistors **dependently**—perhaps making each a ries combination of a 270ohm fixed sistor and a 2.5K variable resistor. One ɔuld conceivably then be able to set › both operating points so that the ro setting coincided with the optimum as on the input device.

Yet while this approach is feasible it ɔuld still not result in a really prac-:al design. For one thing, it will nerally not be permissible to operate vices which are near the maximum read limit at near-zero bias, because if is were done the device dissipation tings would be exceeded. Not only this ıt the current drain of the circuit ɔuld make battery operation virtually ıt of the question even if only **one** the devices were near the maximum nit.

Apart from these considerations the ıearity of the circuit would tend to .ry rather considerably, and with vices having both a low gain and a w Idss it would probably be quite adequate for the instrument to be ken seriously.

If there remain any readers of this ticle at this stage, it is hoped that ese persistent souls will by now have ›gun to agree with the statement made ʼ the author in the introduction: that e design of a voltmeter using low-cost ᶠETs is not quite as easy as it might em. In fact, it would be quite under-andable if such readers were now con-uding that "it can't be done," although tually the situation is not **quite** as ›peless as it now might seem.

Most, if not all, of the problems which ıve been noted would be considerably leviated if JFET parameter spread were stricted. It would appear, then, that a practical design could be produced by freeing our design requirements from the restriction that the circuit should operate correctly with **all** samples of the broad-spread "economy" devices.

If information were available from the device manufacturers regarding the frequency distributions of device parameters within the published limits, it might be feasible to adopt a statistical approach. Such an approach could involve contraction of the effective spread range, working on the basis that a known high percentage of sample devices would fall within the contracted range.

Unfortunately, the statistical information necessary for such an approach is not available, the device manufacturers being unwilling or unable to supply it. Therefore this approach is ruled out, and we are left with apparently only one course: that is, to use JFETs other than our hitherto-assumed randomly selected "economy" devices.

Whether we do this by purchasing "selected" economy devices, or by selecting our own from a purchased random batch, or even by simply forsaking the economy devices in favour of more expensive types with lower spread, the result is going to be inevitable. The effective device cost will rise, and along with it the cost of the instrument.

Hence any practical instrument which may become feasible as a result will be unlikely to satisfy the quest which originally prompted the exercise; it will tend to become a fairly costly "one off" instrument for the laboratory rather than an economy instrument for general workshop and field use.

Be that as it may, however, it would be unconstructive to end the present article without discussing at least briefly the available course of action. Accordingly, this will be done.

It would appear from inquiries made by the author while writing this article that "selected" economy JFETs are not currently available in this country, and that they are unlikely to be made available in the near future. It would also appear that JFETs having significantly reduced spread compared with the "economy" devices, are available only at a cost which would place them well outside the usual sphere of interest for individuals and small laboratories. Hence the only really practical approach seems to be to purchase a batch of random economy devices and perform one's own selection.

This may not be either as difficult or as costly as it may sound. The author found that in a random batch of eight devices of the 2N4360 type, two could be found which both matched one another closely and had Idss and Vp figures which allowed them to perform quite well in a prototype voltmeter circuit. Another two were not quite as well matched as the first pair, but would still perform quite satisfactorily. This may be a rather misleadingly fortuitous example, but it suggests that one might not have to purchase particularly large batches in order to obtain a useful pair of devices.

Figure 7 gives the circuit of a basic voltmeter which may be of interest as a starting point for experimentation. It has been designed to operate from a tapped 18V supply with a pair of 2N4360 devices selected on the following basis:

(a) Id at Vds = − 6V and Vgs = 0 closely matched, and within the range 4-10mA.

(b) Vgs at Vds = − 6V and Id one-tenth that in (a), again closely matched, and less than 7V.

A convenient way to make the selection of devices for this and similar circuits is by using a simple test setup similar to that shown in figure 8. With the gate switch in the lower position, the current meter reads the zero bias channel current, while with the switch in the upper position the voltmeter reads the reverse bias necessary to reduce this current by a factor of 10.

Source resistors R1 and R2 are selected on the basis of the current measured in the zero-bias test in (a) above, so that the JFETs are operated at close to the zero-bias point for maximum gain and linearity. To calculate the resistor values, simply divide the current reading obtained for the devices into 9V. Hence for a pair of devices with a zero-bias current of 4mA, R1 and R2 will be 2.2K, and so on.

It may be noted that a differential

zero set control is used, as with match JFETs only minor adjustment will needed. The calibrate resistor value 200ohms should also be sufficient cope with the reduced gain spread.

Although the basic measuring circu will normally have an input volta sensitivity of less than 1V, it is wise arrange the input divider as shown order that the input resistance can be useful 11M while the JFET gate res tance remains below 2.5M. The reas for this is that for an appreciable pr portion of 2N4360s the gate leaka current Igss will be sufficiently high produce rather serious temperature d pendent drift if the gate resistance ris higher than about 3M.

There is of course room for conside able experiment here; some may fi that with the particular devices obtain it is quite in order to make the lowe range 1V f.s. while still retaining t full 11M input resistance, while othe may elect to scale down the divid resistance to obtain satisfactory dr performance with almost any devic otherwise suitable.

The 100K resistor and zener dio shown on the circuit are for protecti of the input JFET against overlo damage. Although with the divider c cuit shown they would not be essenti they would certainly become so if t divider were altered to allow the inp to be applied to the gate without attenu tion.

In closing this article brief menti should perhaps be made of JFET a MOSFET voltmeter designs more co plex than the simple configuration whi has been discussed herein. As so readers will no doubt be aware, a sm number of such designs have been pu lished, many of them based upon a D feedback amplifier using an input JFE coupled to a silicon NPN bipolar tra sistor. (The configuration is rather sin lar to that used in the JFET prean design published in the May issue.)

Generally speaking, the situation wi such designs is even more complex th with the simple circuit which we ha been considering; a fact which shou scarcely be found surprising in view the increased circuit complexity and t greater number of semiconductor d vices involved.

Many of the problems associated wi such designs are very similar if n identical to those associated with t simple design. Not only this but as f as the author can judge, based upo both a fairly extensive computer-aid analysis and a survey of available d signs and papers, most of the problen which reappear in the more compl designs are even more serious than wi the simple case. And together with thes there are other problems arising fro the additional circuit complexity itsel

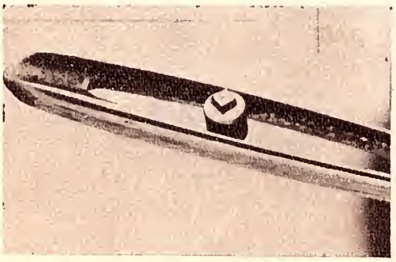
While the more complex designs we not given specific mention in the ma discussion, then, many of the problen discussed will be equally if not mo applicable to them than to the simp circuit which has been discussed.

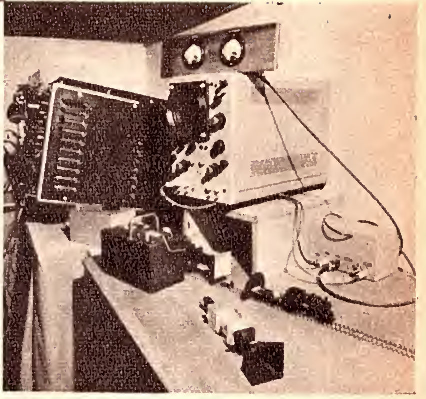
The majority of these designs are i tended specifically for "one off" labor tory applications where a very high i put sensitivity must be attained despi considerable circuit complication, incre sed cost and the need to select individu devices. This being the case, the incl sion in the present article of a discussio of the additional problems associate with such designs was thought to t unwarranted.

KEEPING UP WITH

semiconductors

. . . Gunn Effect Devices





At left is a gallium arsenide Gunn device chip held inside the eye of an ordinary sewing needle to show its small size. At right is an experimental Gunn device 8GHz Doppler speed measuring system which has been developed at Britain's Royal Radar Establishment in Worcester.

The Gunn Effect is a type of "bulk" miconductor oscillation phenomenon in hich a **simple chip** of a semiconductor aterial such as N-type gallium arsenide aAs) is seen to oscillate in the micro-ave region when the DC potential im-ressed across it exceeds a critical value. t was first observed in 1963 by J. B. unn of the IBM Corporation, although had earlier been predicted from theory.

The effect has been studied ainly in GaAs, but is known to occur lso in materials such as indium phos-hide and arsenide, arsenic phosphate and admium telluride. In N-type GaAs mate-ial with a doping level producing 3 x 0^{15} carriers per cM^3, the effect occurs hen the applied field exceeds a thres-old value of the order of 3KV/cM. Vith a typical device having an active ickness of approximately 10 microns 0^{-6} M) this corresponds to an applied oltage of the order of 3V.

The theory of operation is as follows: n semiconductors such as GaAs there re two permissible energy bands avail-ble to conduction electrons, with an nergy "gap" between them consisting of orbidden energy levels. The lower nergy band is that associated with nor-al high-mobility conduction, while in e higher energy band electrons have elatively lower mobility. A high electric eld can excite electrons from the lower nergy high mobility band and transfer hem to the higher energy band where hey have lower mobility.

As the voltage applied to a chip of he material is increased from zero, the urrent first increases linearly with volt-ge according to the material's normal ositive bulk resistance; the electrons are s yet in the lower energy band. How-ver when the applied voltage reaches a ritical value the field intensity at some oint in the material will reach the value vhere electrons are transferred to the igher energy low mobility band. The lace at which this occurs will be a region vhere the doping level is slightly reduced or some reason or another (doping vari-tions, lattice defects, etc.).

The effect of this local excitation is to roduce a "dipole layer" or "domain," onsisting of a carrier concentration ayer adjacent to a carrier depletion layer. Electrons reaching the local excitation region from the negative electrode tend o "bank up" on reaching the region, ecause they suddenly find themselves with reduced mobility; similarly at the positive side of the excitation region, electrons are able to regain their higher nobility and leave the vicinity rapidly, leaving a local shortage.

Under the influence of the applied electric field the domain region drifts through the material towards the positive electrode at the average electron drift velocity. The domain **drifts** rather than extends, because the region as originally produced absorbs sufficient of the device voltage drop to prevent further increase in the region thickness. For the same reason other regions are prevented from occurring, either at the place where the region nucleates or elsewhere in the material.

Until the domain reaches the positive electrode of the device, the effective cur-rent passed by the material is less than that passed just before the domain region formed. Hence there is a nega-tive resistance effect, because current has **decreased** with the increase in applied voltage which was responsible for the production of the domain.

When the domain reaches the positive electrode, it disappears. The "bunch" of electrons in the concentration layer leave the material and the current momentari-ly rises. However, with the domain gone the applied field returns to its form, and almost immediately a new domain nu-cleates to repeat the cycle of events.

As each domain reaches the positive electrode the device passes a spurt of cur-rent; and because the domain repetition rate is governed by the time taken by a domain to drift from the point of nucle-ation to the positive electrode, reducing the thickness of the device permits the repetition rate to be made extremely high. To date Gunn Effect devices have been made to oscillate as high as 25-30GHz (1GHz=10^9 Hz).

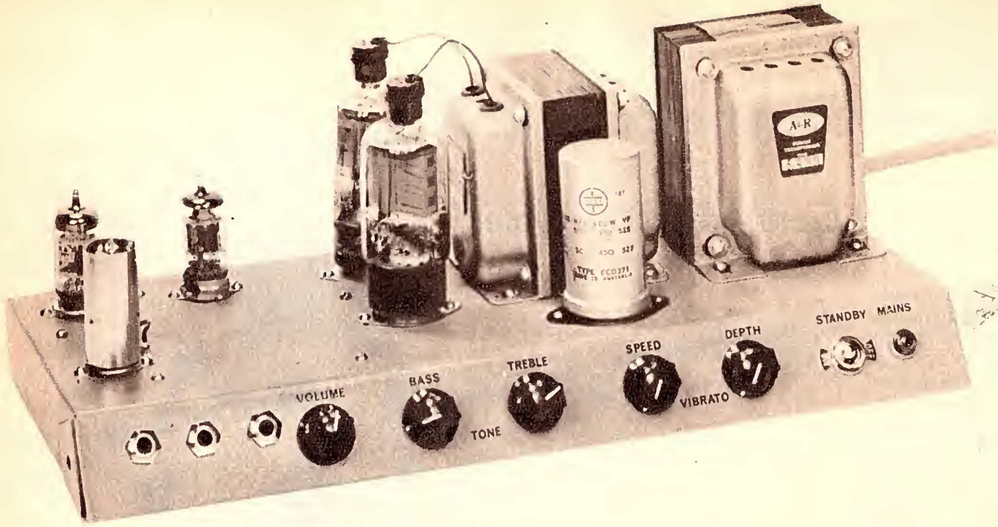
From the foregoing it may be seen that the operation of the Gunn Effect device is rather similar to that of a Klystron valve, in that operation depends upon the time taken by "bunches" of electrons to travel through the device. Note, however, that with the Gunn de-vice the effective transit distance (and hence the transit time) is not a direct function of the actual device thickness, but is actually a function of the dis-tance between the point of nucleation and the positive electrode.

This has produced a number of prob-lems, not the least of which is that as yet it has proved extremely difficult to design a device to oscillate at a given frequency. Similarly it has been found rather difficult to tune Gunn de-vices over a practical frequency range.

Research is currently being made to find new techniques for solving these problems, with some researchers seeking ways to get tighter control over the purity and doping of the semi-con-ductor, while others are examining new device structures and tuning arrange-ments. Research is also being carried out into bulk semiconductor effects other than that discovered by Gunn; for ex-ample at Bell Laboratories they are cur-rently examining devices which operate in a so-called "limited space-charge accu-mulation" (LSA) mode.

There is great expectation that bulk effect devices such as the Gunn device will permit many worthwhile advances in microwave techniques and applica-tions. Already there is talk of "knap-sack" TV link relays and small radar equipments the size of a hand torch.

For those interested in reading further, there are articles on Gunn and associated devices in **Electronics** (February 6, 1967, p. 127, and March 6, 1967, p. 134) and in **Plessey Electronics** (No. 1, November 1966, p. 15). (J.R.)



From the front and from underneath, the 60-watt amplifier looks little different from the 40-watt version featured last month. Note the more elaborate input system.

Guitar Amplifier — 60W Version

Following the presentation, last month, of a basic 40 watt guitar amplifier, we here give details of a more elaborate 60 watt version. Included in this latest design are specially "doctored" input facilities, having fixed amounts of bass and treble boost, and an optional "extra treble" circuit.

By Anthony Leo

In presenting the higher-powered version, we would stress that the rating is genuine: It will deliver to the loudspeaker system an actual output of 60 watts "undistorted." If operated under overload conditions for maximum sonic impact, as often happens with guitar amplifiers, it will deliver more power than this again.

The availability of audio power of this order automatically invokes the problem of providing loudspeakers to handle it. Obviously enough, it would be quite unrealistic to feed it into a system rated for, say, 20 watts and expect from it any kind of performance or durability. Any guitarist who aspires to use a 60-watt amplifier should be thinking in terms of multiple and/or very heavy duty loudspeakers, mounted in an adequate (and probably ponderous) enclosure. Particularly is this so for bass guitars or even ordinary guitars played so as to stress the lower register.

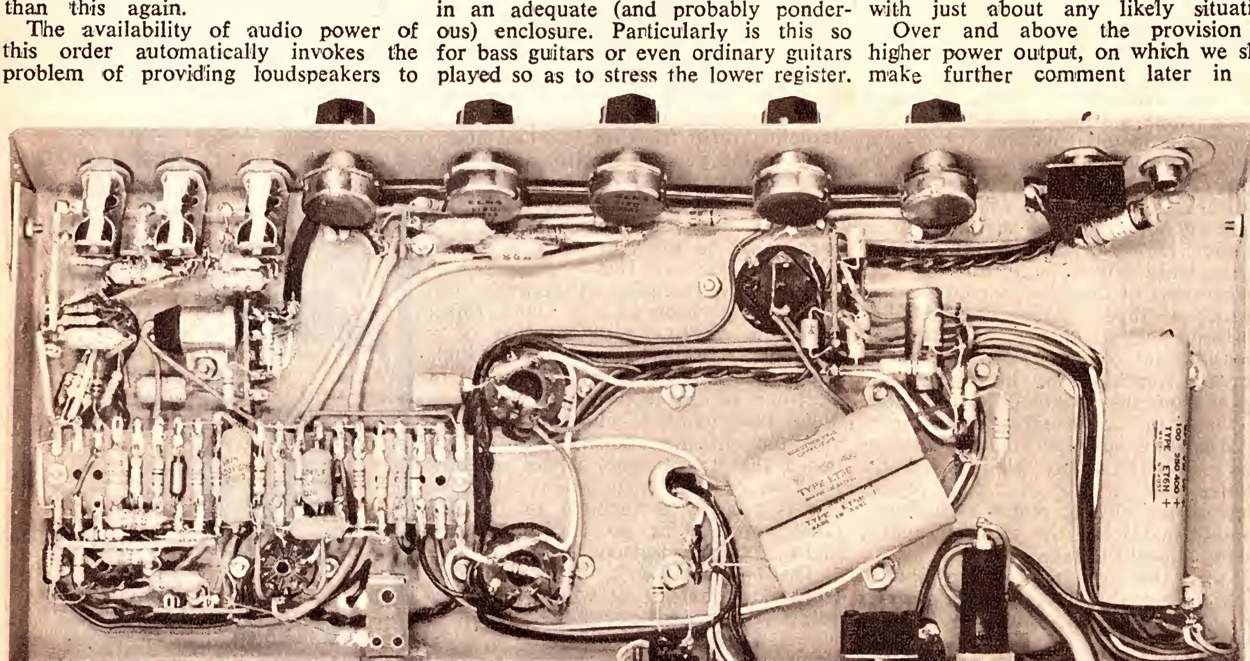
We may be able to say somethin about loudspeakers in a later issue bu for the time being, we can simply poir up the need.

But why 60 watts — a figure we above that provided in the average ele tronic organ?

To some degree, there is a tendenc amongst today's guitarists to regar high-powered amplifiers—and loudspeal ers to match—as status symbols. Wh if they have to be transported i a large car and trundled in on castor It's all part of the deal!

However, there is another side to i in that guitar-group audiences aren exactly noted for their silent attentio and the high power may well be nece sary on occasions to ride over the con peting ambient. But, whatever the m tive, this 60-watt version should co with just about any likely situatio

Over and above the provision higher power output, on which we sh make further comment later in tl



rticle, we have also provided a more laborate input circuit, with three jacks ndividually compensated to favour lead, hythm and bass guitars. The internal ircuitry is such that there is a minimum f interaction between these input chanels. If desired, two or even three uitars may be plugged in simultanously and adjustment of the controls n one guitar will not significantly ffect the balance from the others.

In making such provision, we are not eeking to contradict what is an accepted rinciple in guitar circles. Undoubtedly, he best presentation is obtained when he instruments operate through separate mplifiers and loudspeakers, each independently set up for optimum results. he total available power is greater and ntermodulation is avoided, particularly n overstressed loudspeaker systems.

Provision of multiple, frequencyompensated inputs in our new amplifier erves a double purpose, however:

1. It makes it eminently suitable for ny role, since selection of the proper nput reinforces the action of the tone ontrols in the desired direction.

2. If the amplifier is to be used by nore than one guitar, selection of the ppropriate inputs provides an initial requency differential, thereby simplifyng the task of finding a suitable comon setting for the major controls.

A rhythm guitar is usually played ith the amplifier set for somewhere etween "flat" and modest bass/treble oost, depending somewhat on the play-, the instrument and the music. Acordingly, the input for rhythm accomaniment is "flat," the final balance eing subject only to the amplifier tone ontrols and, of course, the tone controls n the guitar itself.

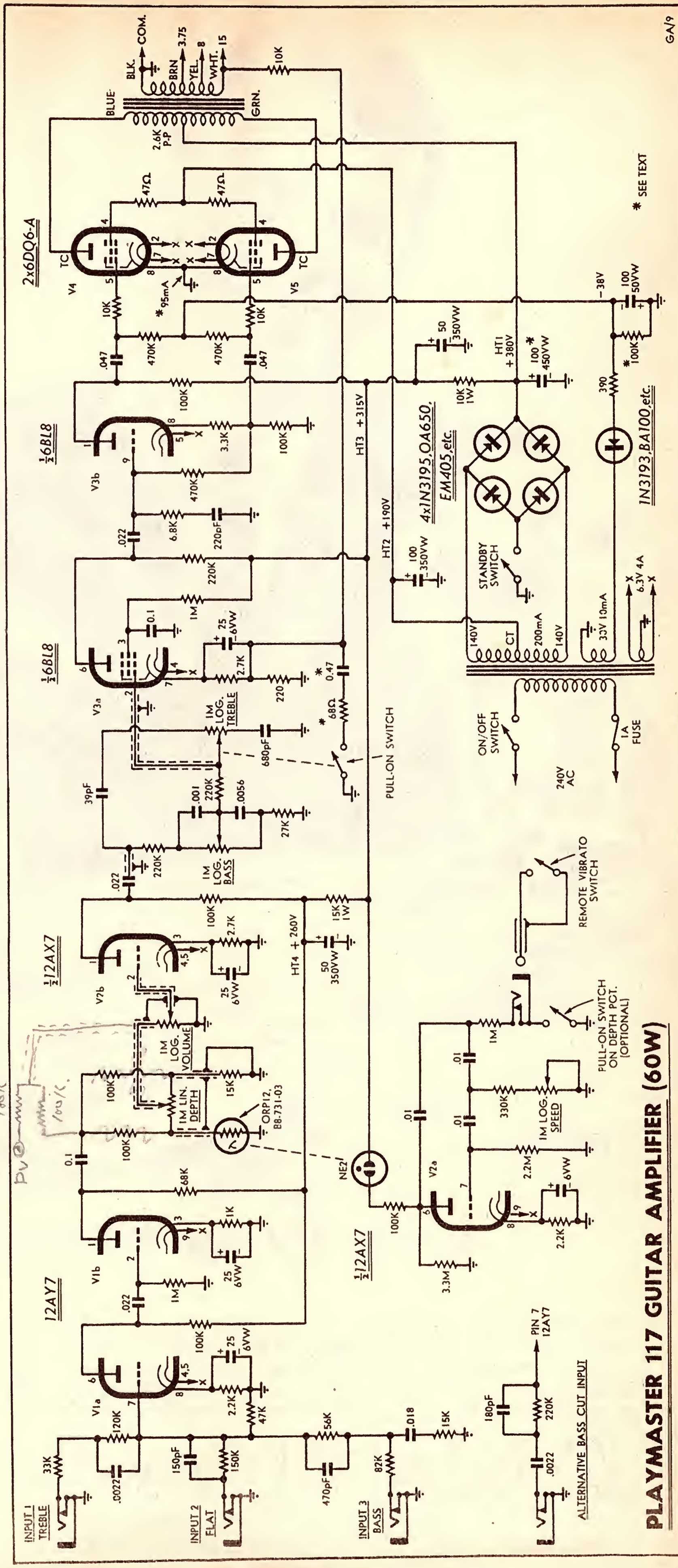
For lead guitar, more treble boost is ormally desired and, accordingly, the nput network for lead guitar provides n additional 6dB boost at 2KHz. With he treble control at maximum, someing over 16dB of treble boost is available at 5KHz, which should meet all ut extreme requirements.

For bass work, the bass input etwork provides an extra 8dB boost t 100HZ, making the total available ass boost about 25dB.

While we show one network of each pe on the main circuit, individual conructors may elect to vary this to suit heir own needs, putting in two "flat" nputs and two "treble boost" inputs nd so on.

While on the subject of options, we how separately in the circuit another type f input network which provides a conderable degree of bass cut. This may be

Superficially, the circuit looks much the same as the 116 design featured last month. However, the revised operating conditions for the output stage, including the use of more expensive grain-orientated transformers, gives a 50pc increase in power output. Other provisions include a more elaborate input system, the use of a premium quality preamplifier valve and an "extra treble" facility operating on the main feedback loop; these latter features can be added, if desired, to the 116 circuit.



PLAYMASTER 117 GUITAR AMPLIFIER (60W)

ARTS LIST

1 Chassis 16in x 7in x 1½in with outward sloping front panel.
1 Power transformer 240V to 280V at 200 mA with centre tap, 30V bias winding, and 6.3V at 4A with centre tap. A and R Transformer type PT5893, or similar.
1 Output transformer 2.6Kohms plate to plate with 3.75, 8 and 15 ohm secondary taps. A and R transformer type OT2842, or similar.
2 Octal valve sockets.
1 9-pin shielded valve socket.
2 9-pin valve sockets.
2 6DQ6A valves, 1 6BL8 valve, 1 12AX7 valve, 1 12AY7 valve.
4 Power diodes, types EM405, IN3195, OA650, or similar.
1 Bias supply diode, types, BA100, IN3193, or similar.
1LDR, type ORP12, B8-731-03, etc.
1 Neon lamp, type NE2.

CAPACITORS

1 100uF 450VW electrolytic.
1 100uF 350VW electrolytic.
2 50uF 350VW electrolytic.
1 100uF 50VW electrolytic.
5 25uF 6VW electrolytic.
1 0.47uF L.V. ceramic.
2 0.1uF 400V plastic.
2 .047uF 400V plastic.
3 .022uF 400V plastic.
3 .01uF 400V plastic.
1 .018 L.V. plastic.
1 .0056uF L.V. plastic.
1 .0022 L.V. plastic.
1 .001uF L.V. plastic.
1 680pF L.V. plastic.
1 470pF L.V. plastic.
1 220pF L.V. ceramic.
1 150pF L.V. plastic.
1 39pF L.V. ceramic.

RESISTORS

½-watt, 10 per cent, unless specified.
1x3.3M, 1x2.2M, 3x470K, 1x330K, 3x220K, 1x150K, 1x120K, 8x100K, 1x82K, 1x56K, 1x47K, 1x33K, 1x27K, 1x18K, 2x15K, 1x15K, 1 watt, 3x10K, 1x10K, 1 watt, 1x6.8K, 1x3.3K, 2x2.7K, 2x2.2K, 1x1K, 1x470 ohms, 1x220 ohms, 1x68 ohms, 2x47 ohms.

POTENTIOMETERS

4 1M log. (C-taper).
1 1M linear (A-taper).

MISCELLANEOUS

1x8-way tag strip, 2x6-way tag strips, 1x5-way tag strip, 1x4-way tag strip, 1x3-way tag strip, 3x2-way tag strips, 21 lug length of miniature resistor panel.
2 single pole toggle switches.
1 pilot lamp assembly.
1 fuse holder.
4 "shorting" type jack sockets and plugs.
1 4-pin speaker socket and plug.
Power flex and plug, clamp and rubber grommet, knobs, shielded cable, hookup wire, nuts, bolts, washers, solder, etc. Remote foot switch and mounting, if desired.

:ful in situations where one guitarist nts consistently to use more ss boost in the amplifier than a second itarist finds acceptable.

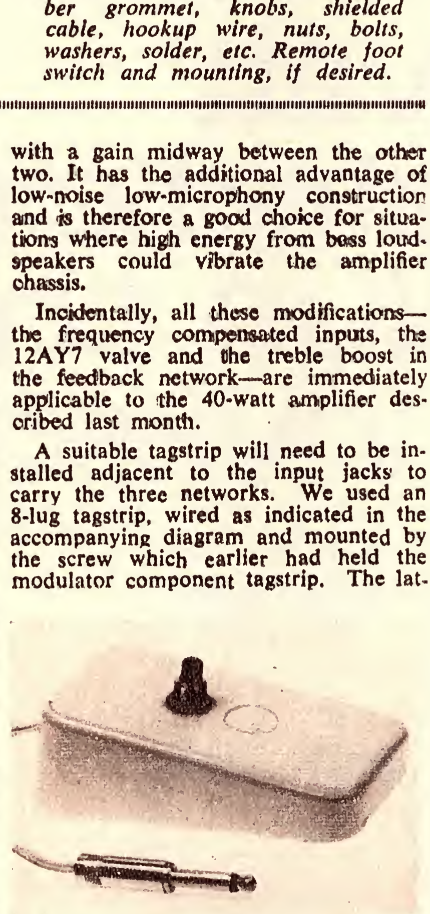
A further option is a modification to : main negative feedback loop which ll provide the amplifier with an additional 6dB of treble boost at 3KHz. : devised the modification after observ- ; that a particular group, who checked : amplifier for us, seemed to regard ormal" treble as something above what :ual measurement showed to be level. e modification can be wired in per- ınently or brought into circuit by :ans of a "pull-on" switch attached the rear of the treble tone control. this way, operation of the switch will d 6dB of treble boost to whatever the ntrol would otherwise determine.

Obviously enough, any treble boost obtained from the feedback network ıst be at the expense of the total ective feedback. In other words, if we ve 16dB of negative feedback and we sh to provide 6dB boost, the feedback ll of necessity be reduced by about B at the boosted frequencies. For- ıately, 10dB of negative feedback is equate for an amplifier of this type. ıe network consisting of a 680 ohm istor in series with a 0.47uF capacitor shown dotted on the circuit diagram.

The modified input networks intro- ce an inevitable loss of gain which uld render the amplifier not quite ısitive enough for low output guitars. :placement of the 12AU7 in the first ıge with a 12AX7 would more than 'set this but could mean that the input cuits might overload too readily with gher than average signal voltages. :cordingly, we have specified a 12AY7, less well known premium-quality valve, with a gain midway between the other two. It has the additional advantage of low-noise low-microphony construction and is therefore a good choice for situations where high energy from bass loudspeakers could vibrate the amplifier chassis.

Incidentally, all these modifications—the frequency compensated inputs, the 12AY7 valve and the treble boost in the feedback network—are immediately applicable to the 40-watt amplifier described last month.

A suitable tagstrip will need to be installed adjacent to the input jacks to carry the three networks. We used an 8-lug tagstrip, wired as indicated in the accompanying diagram and mounted by the screw which earlier had held the modulator component tagstrip. The lat-



The vibrato off-on foot switch is the same as specified for our original Playmaster 102 and 103 guitar amplifiers. It can be used as well as or instead of a switch on the rear of the "Depth" control potentiometer.

' has been relocated further back, both avoid crowding and to keep later ring away from the input components.

Having looked at the modified input rangements, we can describe the modi-ations to the output and power supply iges, necessary for the amplifier to liver the additional 20 watts.

As we mentioned last month, ; power output stage employs two)Q6A power valves operating push-pull class AB1, with fixed grid bias. In ; 40-watt unit, the total cathode cur-it for the two valves was 100mA

'OWER: 60 watts RMS output.
)ISTORTION: Total harmonic distortion at 60 watts output is 2 per cent, and 1 per cent at 55 watts output.
NPUT SENSITIVITY: 20mV for 60 watts output at 500Hz.
.OAD IMPEDANCE: 3.75, 8 or 15 ohms.

iescent), a figure determined mainly the amount of negative grid-is applied.

To obtain the additional power out-t, it is necessary to modify the erating conditions of the output lves, involving a slight increase in ite voltage, a slight increase in grid nal swing and a reduction in the ite-to-plate load impedance from 3300 ms to 2600 ohms.

The increase in supply voltage must countered by a reduction of 5 milli-ips in standing current, if the plate sipation of the output valves is to be ot inside the limit figure of 18 watts iece.

Reduction of the quiescent current turally involves a modification to the is supply, the required bias now ng about −38 volts. The bias voltage ould be adjusted, by varying the 100K int, to give a total cathode current 95mA.

Other than the bias supply, the power oply components, with the exception the power transformer itself, are the ne as those for the lower power sion.

Although the quiescent current has en reduced, the current drawn at the iks of the signal excursion will be isiderably greater than it was for the watt version, substantially increasing average current drawn under dyna-c conditions. This, together with the reased HT voltage, means that the wer supply is called upon to deliver ostantially more power.

The new power transformer has a ondary voltage rating of 280V over-with a nominal current capacity of 0mA.

Although both transformers must ndle considerably more power in this iplifier, they are physically no larger in those for the 40-watt version. This made possible by the use of grain-entated laminations in the transformer es.

When the silicon steel for transformer ninations is rolled, an alignment of crystaline structure occurs, forming grain in the direction of the rolling. It found that the steel presents less re-tance to the magnetising force, along grain, than it does across the grain ucture; reluctance is the magnetic alogue of electrical resistance. By stamping-out laminations with the grain orientated in the direction of the longest magnetic path, a transformer can be produced which has lower magnetic resistance and so higher flux density in its core.

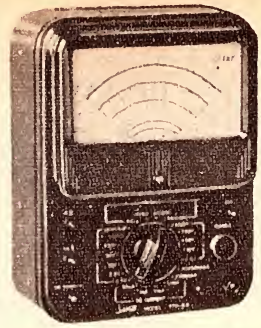
By selecting high quality material, taking advantage of grain orientation and using thinner than usual laminations to reduce eddy current loss, it is possible to produce transformers which will handle considerably more power than regular transformers of the same physical size.

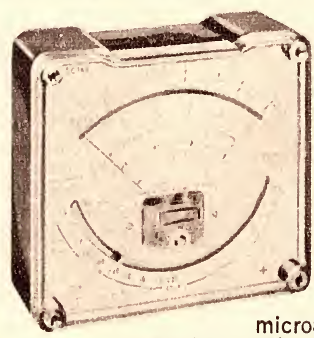
Not surprisingly, there is a price to be paid for this and the higher rated power transformer, together with the new output transformer, will cost several dollars more than those for the 40-watt version. (The transformers used in our new amplifier were A & R types, PT5893 and OT 2842, but equivalent units will probably be made available by other manufacturers.)

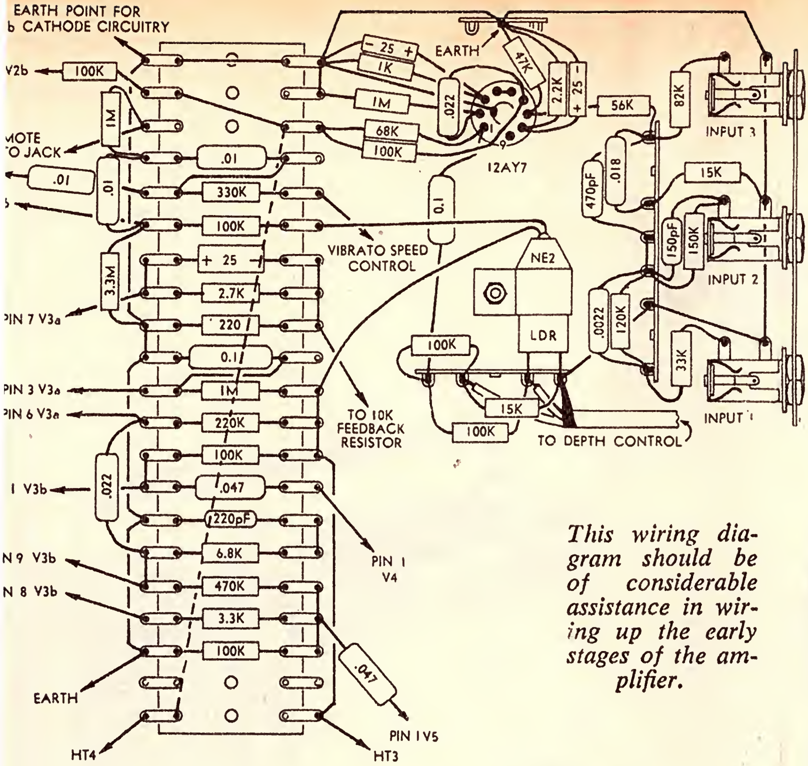
Apart from the new transformers and the modified input circuitry, the layout of the basic amplifier has not been changed.

Again we are using the previously described vibrato system, wherein "modulation" of the guitar signal is effected by means of a light dependant resistor in a balanced resistance network. Guitarists who tested the amplifier voted it as about the best vibrato they had ever used, the amplifier showing no tendency to "pump" the loudspeaker cones. The vibrato may be switched by either a switch on the depth control, as indicated in the circuit, or activated by a remote foot switch.

The remote vibrato on/off switch, as pictured, consists of a robust "button" switch, mounted in a small plastic box which has been suitably tapered to a wedge shape, so as to facilitate foot operation. The actual switch may be either of two types, a push-on and push-off type or a push on type with a self returning spring action. Either way, the assembly must be of such construction







This wiring diagram should be of considerable assistance in wiring up the early stages of the amplifier.

:o stand plenty of knocking about. foot switch is connected to the amp- · by a length of small diameter :e-8 twin flex with a standard tele- ne jack.

'ur switch container was made from mall plastic box manufactured by :kin Wynne Pty. Ltd. and measuring x 2-5/8 x 1-5/8in. The rear edges e tapered to obtain the wedge shape two holes drilled, one toward the ;h" end and on top to mount the tton" switch and the other in the ı end itself, through which the cord ;es. In addition to a grommet being :ed in the latter hole, some means ecuring the cord should be provided, prevent mechanical strain being :ed on the soldered switch connec- ıs.

hould a more robust foot switch be ıired, an auto headlamp dip switch ld be mounted in a metal box; the al box could be folded from heavy ge sheet aluminium. An alternative ıngement might be a wedge shaped oden block which has been suitably owed out so as to accomodate the tch.

A switch which appeared to be rugged enough to withstand severe punishment is made by Alpha Engineering Co. Pty. Ltd. of Sydney, and marketed under the trade name of "Alpha."

Construction of the amplifier is virtually identical to the Playmaster 116, with the exception of the additional tag strip at the input which we mentioned previously.

Again we would sound a word of warning regarding the feedback connection, which should be made after the output and driving stage is functioning normally. If the amplifier remains stable after the feedback connection is made and there is a drop in the level of any test signal from the amplifier, the feedback is negative and all is well. If the gain increases, however, and/or the amplifier howls, it is a sure sign that the feedback is positive.

Since it is logical, and an unwritten law, to leave the common end of the secondary earthed and not to cross over the flying leads to the output valves, the simplest modification is to swap over the "drive" leads from the component board to the grids of the two output valves.

ERRATA AND NOTES

Playmaster 115, April, 1967. Corrections to parts list: The power transformer secondary should be 70V.CT, not 75V.CT. The balance potentiometer should be 2M (lin), not 1M.

ıSIC RADIO COURSE:

On page 61 of this issue we present what is, in effect, an additional chapter for your "Basic Radio Course"—the first of two which will cover the subject of television. The author, by the way, is our Associate Editor, Philip Watson.

You may care to cut out the relevant pages and keep them inside your copy of the course.

For those who may not have been aware of it, complete bound reprints of the Basic Radio Course (Chapters 1-24) are available from our office at $1.50, or at $1.60 posted to any address in Australia.

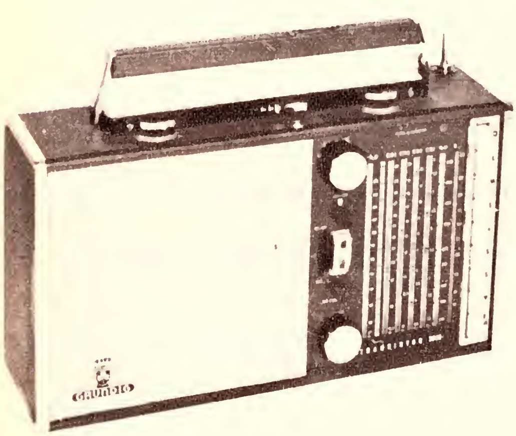
Grundig world-range radios

TR5000

The Grundig name has become a legend for quality in radio sound. And with radios like the extraordinary Grundig Sattelit, it's no wonder! You can be an eavesdropper on the world. Two Superphon dynamic loudspeakers give you world-wide reception on thirteen wavebands—with an unbelievable depth and clarity of sound. Short wave, FM, bandspread, too! The Satellit TR5000 is designed to operate on batteries or AC mains, and receives VHF/FM, long, medium and short wavebands. The short wave coverage ranges from 10 to 187 m., split into four bands.

Additionally, six bandspread short wave ranges are provided, shown on a separate scale with a rotating drum selector. The Satellit is fitted with 17 transistors and 11 diodes. It features a short wave fine tuning dial, automatic frequency control on FM, R.F. stage, a switchable ferrite aerial, a double extension telescopic aerial, a separate control for the bandspread short wave tuner, duplex drive on FM/AM, a tuning and battery indicator, and two multi-octave loudspeakers. The Satellit also has an illuminated tuning scale and separate bass and treble controls. Sockets are provided for headphones, external aerial and earth, car aerial, record player, tape recorder and external battery power supply.

The Satellit transistor 5000 has a handsome padded graphite case with chrome and satin silver trim. It measures 16" x 10" x 4¾".



TR3000

The Ocean Boy TR3000 is not just a transistor radio, it is a perfect piece of precision engineering. The whole world's your oyster with the Grundig TR3000. Choose a wavelength by pressing one of the nine buttons and using the fine tuning control. See visually when you are at the point of best reception by the tuning indicator (which doubles as battery indicator). Adjust the bass and treble tone controls and you're hearing a radio that's built for listening to, not straining at. The Ocean Boy has two loudspeakers, 13 transistors, 8 diodes and 2 rectifiers. Provides matchless listening on VHF/FM, long, medium and 4 short wavebands (10 to 185 m.). Output is up to 2 watts (R.M.S.).

GRUNDIG

GRUNDIG SALES & SERVI

By Goldring Engineering (A'sia) Pty. Ltd

N.S.W.:	443 Kent St., Sydney	29-1275/6
VIC.:	368 Little Bourke St., Melbourne	67-11
W.A.:	91 Hay St., Subiaco, Perth	8-4988
QLD.:	King & King, 77 Queen St., Brisbane ..	2-37
S.A.:	77 Wright St., Adelaide	51-51

GEP3

GRUNDIG . . . the world's largest manufacturer of tape recorders . . . stereograms . . . and dictating machines.

The Serviceman

WHAT'S IN A NAME—OR A BRAND?

"Someone's not playing the cards I dealt 'em!" So runs the rather classic quip. Perhaps not surprisingly, it came to mind when I sat down to recount this month's main story.

It began in a perfectly routine fashion /ith a telephoned complaint from a set ·wner that the picture on his TV screen /as getting less and less clear and he'd ecided that it was about time he had omeone look at the set. He volunteered, urther, "that the picture seemed to have vriggly dots all over it."

From the description, I gathered that ie "wriggly dots" would probably be /hat we would more commonly describe s "snow" or "noise" in the picture — nd this is what it turned out to be, /hen I was at last confronted by the ffending receiver.

Perhaps a word of explanation would ot be amiss for the rising generation of /ould-be servicemen:

Most of the spurious signals which roduce these disturbances on the screen ccur in the circuits and valves in the ront end of the receiver itself, and are ue to slight irregulatities in current ow. With a strong input signal these isturbances are so weak by comparison hat they are of little consequence. Pro- iding the set's AGC system is working orrectly, so that the gain of the set ; suitably reduced to prevent overload, iis favourable signal-to-noise ratio will e maintained right through the set to ie picture tube. The picture is, there- ore displayed to best advantage.

However, when the incoming signal is 'eak the disturbances in the front end ircuits may well approach them in mag- itude, resulting in a poor signal-to- oise ratio. To be sure, the AGC system /ill have sensed the weaker signal and dvanced the gain of the set to cope /ith it, but this will do nothing to im- rove the signal to noise ratio. All that /ill happen is that the disturbances will e amplified along with the wanted sig- al, and eventually appear on the picture ibe screen as "wriggly dots." In an or- inary sound-only receiver, the spurious ignal is heard as a rushing or swish- ig sound and the term "noise" is there- ore appropriate.

In a television receiver, the same henomenon produces "wriggly dots" on ie screen, mixed up with the wanted nage. In some cases, the effect is de- :ribed as "snow" but, in technical ircles, it is more usual to stick to the 'ord "noise." In fact, "noise" is used ery widely throughout the electronics idustry to describe the spurious energy 'hich a circuit or a piece of equipment iperimposes on any kind of wanted lectrical signal.

Well, after that "Answer Man" effort, d better get back to my original story.

Taken out of a television tuner, this valve is very clearly branded 6BQ7A, but . . . .

Faced with visual "noise" in a television receiver, the first thing to suspect is the aerial and its connections, for any fault here will interrupt the signal to the receiver, causing the AGC circuit to advance the gain in an effort to compensate — with the result already outlined.

So I slid the set out from the wall, checked to see that both sides of the aerial lead-in were connected — to the right terminals — and that the input was not being shorted out by a stray strand of wire. But everything appeared to be in order in this department, and with the lead-in to where it disappeared through the wall.

So I walked out through the back door and followed its further path along the wall, out over the guttering and up to the aerial. Again, as far as I could see, nothing was wrong but I did note that, helpfully, the aerial was of a type having a folded active element that should show up as a DC short across the ends of the feedline. Accordingly, I disconnected the lead-in from the set and measured across the two ends with an ohmmeter. It showed very low DC resistance, indicating that the circuit was apparently complete, up one feedwire, through the folded dipole and back down the other feedwire.

Assuming the aerial to be in order, the noise problem looked like having to do with the receiver itself.

Typically, there could be a faulty valve in the tuner or a faulty component, connection or contact. If any of the latter, I might face the decision of having to fiddle with the tuner on the spot, risking waste of time and possible failure, or else taking the tuner out and sending it back to a repair depot. Understandably, servicemen don't like faults in tuners!

As against a possible tuner fault, there was one other "hope" — a fault in the AGC circuit to the IF amplifier. If an open resistor or a leaky bypass capacitor prevents AGC voltage from reaching the IF system, it operates "flat out" and causes a very high AGC voltage to be applied to the tuner. If the tuner AGC is high enough to cut off plate current in the RF amplifier valve, only the merest trace of signal may get through but the IF amplifier will amplify it, along with "noise" from the frequency changer, to produce a "noisy" picture.

But, with the hope that it wouldn't be as complicated as all this, I reached in and pulled out the RF amplifier valve — a 6BQ7A. What there was of the picture disappeared forthwith. Reaching into my kit, I pulled out a spare 6BQ7A, plugged it in and waited for the picture to reappear — I hoped, free of noise.

But in vain. The picture, when it appeared, was even "noisier" than before!

Strange, my spare 6BQ7A must be a dud! With some misgiving, I went out to the truck and brought in a couple more. But neither of these was any better. Yet, when I put back the original 6BQ7A, the picture reappeared in its original, rather noisy form.

What the hec?

Then, suddenly, the bells began to ring. The set was of a type which always used a particular brand of tuner and these tuners NEVER used a 6BQ7A! They always used a 6ES8.

What was I doing then, plugging in 6BQ7A's? And how come that I'd pulled a 6BQ7A out of it?

So, for the first time, I took a good look at the original "6BQ7A." Despite its very clear brand, it was nothing of the kind. Instead of the two slim triode structures inside, it had the more involved and bulky shielding that characterised the 6ES8 that it should have been — and was!

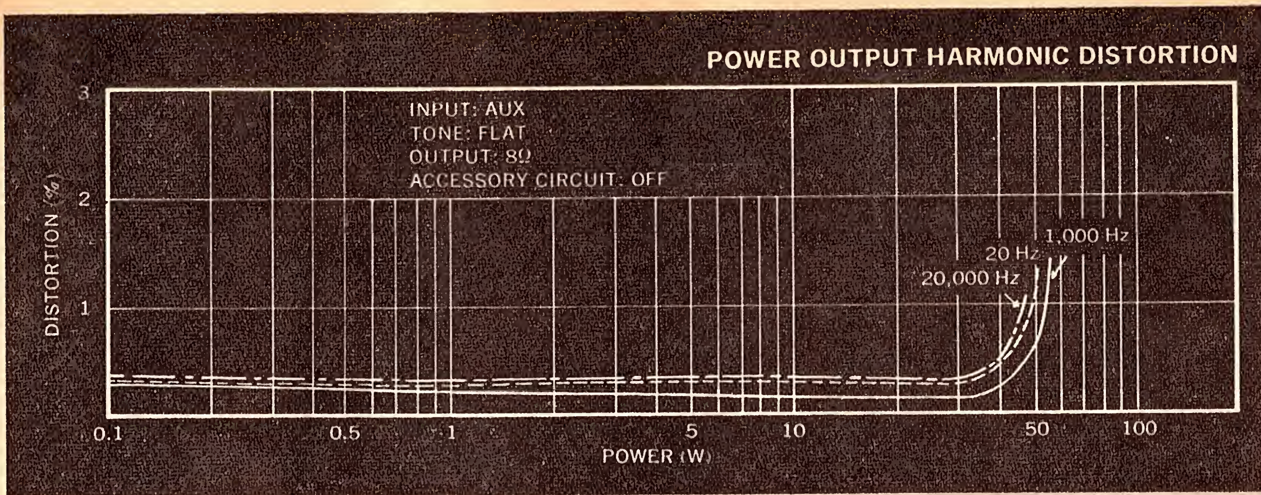
And, sure enough, when I plugged in

More light on colour television

Strictly incognito, your Serviceman was wandering around the recent IREE convention displays and noted a photographer getting all set to take some pictures off one of the colour television screens. A few minutes later, the program began to roll and the photographer started systematically to snap the best scenes—with the aid of a flashlight!

What a set of pictures would be his reward . . . a whole roll of pictures of a colour set with a blank screen.

Somebody should have told him that a colour television image is not an object—therefore it can't be illuminated by incident light. The image is itself a pattern of light and hitting it with a flash would simply wash it out. What would happen to the picture on the screen of your favourite drive-in if all the cars turned their headlights on to it?



Sansui lays it on the line

Look at that distortion curve.

It, better than pages of exaggerated advertising claims, tells the serious stereo fan something about the kind of engineering that has gone into building a receiver.

While this curve belongs to Sansui's Model 3000, it is the result of the same engineering, the same careful component selection, and the same precision fabrication that goes into every product carrying the Sansui name.

Sansui's line of audio equipment includes more than a dozen quality receivers at all power outputs — solid-states, tube types, single or multiple band tuners, amplifiers, amplifier-tuners—as well as matching speaker systems and stereo headphone sets.

Pick up specifications for any Sansui product and you'll find performance and distortion characteristics laid on the line as few stereo equipment manufacturers would dare.

Then listen to a Sansui at your dealer for a frank personal appraisal.

Sansui model 3000: Solid-State AM/FM Multiplex Stereo Receiver. Total output power: 130 watts. RMS power: 48/48 watts. Stereo RMS power: 45 watts x 2. Bandwidth: 20 to 20,000 Hz. Harmonic Distortion: less than 1% at all power levels.

Sansui®

SANSUI ELECTRIC COMPANY, LIMITED: 14-1, 2-chome, Izumi, Suginami-ku, Tokyo, Japan Tel: 328-0111 new 6ES8 the picture came up with xactly the same order of noise as when had first switched it on.

As it transpired, the noise disappeared ie moment I replaced the frequency ianger — which was the next step — it I left the place with a shake of the ead. As if television receivers haven't iough tricks of their own, without bug-ng them with wrongly branded valves!

How did it get there in the first place? ecause, I imagine, people in the valve ctory identify valves by batches and by ppearance, rather than by reading every dividual type number. And the same ould go for the person who plugged the rongly branded valve into the tuner. looked right, it worked right and it as right — except for the brand.

But what a mess I'd have got into if hadn't been quite so familiar with the articular brand of receiver!

As compared with this call, which was ery much out of the ordinary, the next ill on my list was of the kind that I on't enjoy, any more than any other erviceman.

The complaint, in this case, was that e set had lost its picture altogether, part from a few white streaks. When took a look at the screen, I quickly alised that the white streaks were mply highlights from the picture — the ily part of it that was visible.

It seemed clear enough that the bright-ess circuit had developed a fault so that, 'en turned right up, the brightness con-ol did not raise the picture tube above eam cut-off. In an effort to correct the tuation, the owner had turned the ontrast to maximum, causing just the eak whites to break through.

A bit of probing around the leads to ie picture tube socket confirmed that e grid potential was well below cathode otential, irrespective of the brightness ontrol setting. This much was not hard verify. The unwelcome thought was iat the component responsible, either a sistor or a bypass, was hidden away in ie chassis, which was going to take me half-hour or so to remove and re-istall. I did it without much in the way f good grace and my mood wasn't im-roved when the owner quibbed about ie fee, on the grounds that I surely asn't going to charge all that for one ny little "resistor thing."

But, if there was a risk of generating ard feelings about owners in general, ie temptation was countered by the nowledge of the "swifty" that a few ervicemen have been known to pull in iese same circumstances.

Through ignorance or by design, iey blame the dim picture on a failing ibe and proceed smartly to sell and fit picture tube brightener. Prompted by ie increased heater voltage, the tube roduces a more normal picture — for time! In fact, the receiver still contains ie original fault but, by the time it is aced and corrected, the picture tube on its way to an early demise.

I wonder how such operators can eep at nights.

By way of a change from television, ere's a story which may be of interest "audio" types.

It actually started with a call to fix fault in a television set—a call and fault which, in themselves, would not ave warranted any comment. However, 'ith that job done, the owner asked ie whether he could pay for a few xtra minutes of my time, to have a ook at a peculiar fault in his home-iade hi-fi system.

I hummed and harred for a few moments, to clear the way for a hasty retreat, should it have proved to be necessary. Home constructors don't always realise that it involves an outlay of real time to become familiar with their circuits, their method of construction and their problem before one can begin to diagnose and "prescribe." And somebody has to pay for this time, if the serviceman is not to work for nothing!

As it transpired, the equipment was not home constructed in the normal sense of the term. My client had bought a crystal cartridge, player, amplifier and loudspeakers separately and assembled them in his own cabinet. And I must say that the sound was excellent, considering his relatively modest outlay.

The one trouble was that the system would not play the extreme outside grooves of a few of his records—and this he proceeded to demonstrate. The pickup could be lowered manually on to the run-in grooves, would appear to "seat" normally and then, just before the music started, the pickup would jump inwards by about 1/8-inch, missing the opening stanzas altogether. On other records, it was perfectly normal.

The natural thing was to suspect some roughness in the vertical bearing, causing the pickup to jump over a high spot. But I certainly couldn't feel any roughness—and why should it happen so positively on particular records, with no hint of trouble on others?

Close examination revealed that the records which were giving trouble were those with a rolled, rather than a flat edge and my first guess was that the stylus was simply sliding downhill. But lowering the pickup gently to where there could be no "hill" didn't overcome the effect. However, in an effort to clarify the situation I undid a couple of screws and propped up one end of the motor board so that the pickup arm had to climb up a definite incline towards the centre of the record. But, alas, on the troublesome records it flipped towards the centre as positively as ever.

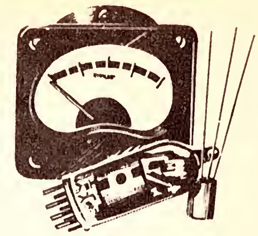
In an effort to watch more closely the behaviour of the stylus in the groove, I got down on my haunches, end on to the pickup and had my client hold a torch on the scene while I slowly lowered the pickup into the outer groove.

And, suddenly I spotted the cause. On either side of the stylus, the underside of the cartridge had a slight shoulder, perhaps intended to limit upward thrust of the stylus in the event of the pickup being dropped on to the record. Normally, the shoulders rode just clear of the surface but, on the troublesome discs, the outer shoulder in this case was just fouling the rolled edge. Just as the drag on a stylus tends to pull a pickup towards the centre of a disc, so this unusual friction flipped the pickup violently inwards.

I suggested to the owner that the stylus may have been bending—or have been bent—by excessive playing weight, or that the socket through which it excited the crystal may have been slightly out of position. Yet again, he might be able, very carefully, to file away a little of the offending shoulder.

What he will do about it I'm not sure but my impression, as I took my leave, was that he would probably buy a new cartridge. I gained the impression that he'd been looking for an excuse, anyway, to shout himself a new diamond-tipped ceramic!

Basic Radio Course



CHAPTER 25: Television. Basic concepts. The elemental area. Scanning. Electronic scanning. Deflection systems. Interlaced scanning. Synchronisation. Vertical and horizontal pulses. Sync. separation. Camera tubes. Iconoscope, Image Orthicon, Vidicon, Plumbicon. TV standards. Number of elemental areas. Bandwidth.

No discussion of "radio" would be :omplete without at least a mention of elevision. Unfortunately, a complete and letailed description of modern TV sysems would require as much space as ve have devoted to our entire radio :ourse, so the best we can hope to do n a couple of chapters is to put the tudent on nodding terms with the subect. This will at least prepare him for nore serious studies.

Perhaps the best place to start such a liscussion is with the TV image itself — the form it takes and the reasons vhy the eye is able to accept it.

Consider the eye first. It has two charcteristics which make TV possible; both ılready exploited in other spheres. Probbly tne best known is "persistence of ision" — the fact that the eye retains he image of a scene for about 1/16 second after the scene itself has been renoved.

It is this fact that makes motion picures possible in the form we know them, ince it enables a series of still pictures, resented in quick succession, to appear s a continuous picture, with small differnces between them appearing as movement. In practice, motion pictures use nything from 16 pictures (frames) per econd for amateur systems to 30 frames er second for some of the more elabrate wide screen theatre systems. More onventional theatre systems use 24 rames per second.

The other characteristic which we redit, in broad terms, to the eye is its bility to accept, as a complete picture, n image which is, in reality, composed f a number of small discrete areas. A lassic example is the "half tone" reprouction of a photograph in a newspaper r magazine. Since the printer has no ray of presenting actual tones between ne white of the paper and the black f the ink, he resorts to the trick of reaking grey areas into patterns of tiny ack dots, their size relative to the surounding white areas determining the nade of grey. The eye accepts this as a omplete picture.

In part, this reaction is undoubtedly ue to the simple physiological fact that ne eye cannot resolve detail below a ertain minimum size. Thus if we view ny reproduction at a sufficient distance ne eye simply cannot resolve the deects and the viewer is therefore not onscious of them.

However, this is not a complete explanation. The fact is that the impression of a recognisable image, complete with varying shades of grey, is retained even when the dot structure is coarse enough to be clearly visible. This suggests that there is a psychological basis for this phenomenon, whereby the mind "fills in" the missing detail.

In any case, and whatever the reasons, the fact remains that the "eye" is remarkably accommodating in this regard. It is this fact that makes the TV image as acceptable as it is.

Now let us consider how the TV image is constructed.

In order to transmit an image from one place to another, electronically, it is necessary to divide the image into a large number of discrete areas (much like the dots in the newspaper reproduction discussed above), measure the light value of each area, and convert this to an electrical signal suitable for transmission to the distant point. At the distant point the process is reversed. The signal is used to generate light which has a similar value to that of the original image area it represents.

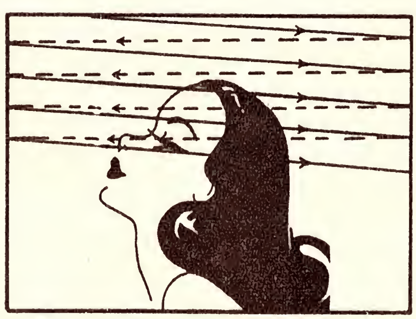


Figure 1. An elementary scanning pattern. The solid lines represent the scanning movement, the dotted lines the retrace action. The distance between the lines is exaggerated to simplify the drawing.

Assuming that we make the discrete areas small enough and re-assemble them all in the right order at the distant point, the eye will accept the presentation as that of a complete picture. We do not even need to present all the areas at the same instant. Assuming that we can present them rapidly enough, such that they are all presented in about 1/16 second, we can present them one at a time and the eye's persistence of vision will retain them all and form a complete picture.

This is important, because it would be impractical to provide a separate circuit between each ELEMENTAL AREA at the transmitter and its opposite number at the receiver. On the other hand, it is relatively easy to interrogate each elemental area on a sequential basis, transmit the information it contains, then move on to the next one and repeat the process. When the last element in the picture has been interrogated, the system starts all over again with the first element and transmits another complete picture. Again assuming that this can be done at 1/16 second — or faster —the eye will not only see a continuous picture, but will be able to observe any movement that occurs

This, then, is the broad basic principle of television; divide the image into elemental areas, interrogate or SCAN each area sequentially, convert its light value to an electrical signal, transmit the signal to the distant point, convert it back to light, and re-assemble each elemental area in its correct relative position. Do this at least 16 times a second and the eye will see a continuous moving image.

So much for the broad picture. How do we achieve all this in practice? How do we scan the elemental areas? How do we convert light into electricity and back to light again? How do we keep the receiver scanning in step with the transmitter? What are the practical standards of modern TV systems?

Scanning an image for TV transmission has been tackled in many ways, including a wide variety of relatively crude mechanical systems used by early experimenters. While we are not interested in the mechanical details of these systems, the broad principles they employed may prove helpful in explaining the scanning concept. (Figure 1.)

As a simple explanation, let us suppose our subject is a large two-dimensional object, such as a poster or sign. And let us further suppose, that, for the moment, we are not interested in transmitting movement.

Facing the poster we set up a bank of photo-electric cells. There are many forms of these, but they all perform a similar function—the conversion of light into an electrical signal approximately proportional to the light intensity. Some cells do this by actually generating electrical energy from the light energy. Others vary their resistance and so control an external source of energy.

We start with the poster in near-dark conditions so that little or no light is reflected from it on to the cells. Then we take a concentrated light source, such as a spotlight or sharply focused torch, and shine a small spot of light on the top left corner of the poster.

he size of the spot constitutes our emental area and the smaller we can ake it the more detail we will be ›le to transmit to the distant point.

From the top left corner we move ıe beam to the right at a steady rate, ›eping it parallel to the top edge. As e do so, the light reflected into the ›oto-cells will vary according to the ıttern of the poster. Where it is white e cells will receive the maximum nount of light, where it is black a ınimum and, for intermediate tones ›propriate amounts of light. These variions will be converted into similar ıriations of current and transmitted to ıe distant point.

When the light spot reaches the top ght hand corner it is flicked quickly ıck to the left hand side and, at the ıme time, downwards by the diameter the spot. It now traces a second line, ırallel to the first, with the top of the ›w line just touching the bottom of the ›evious one. Thus, another line of in›rmation is transmitted to the distant ›int.

This line-by-line analysis continues un- the last line is traced at the bottom the poster and the spot reaches the ›ttom right hand corner. Then it is ›cked back to the top left corner again ıd the whole process repeated.

As a receiver, we might envisage a simır spotlight, arranged to illuminate a reen and scan it in exact unison with e one at the transmitter. The signals ›m the photo-cells, suitably amplified, ›uld be used to control the light innsity. Provided the whole process was ›mpleted within about 1/16 second, the e would see a complete picture.

Although we selected a poster as a nple subject to explain the process, is system could be used — and, in ct, was used in early experiments — televise conventional scenes and ob›ts, including people. Movement is porıyed almost automatically, once we ınsmit successive pictures with suffici›t rapidity to present a continuous ıage.

A serious objection to this scheme is at it can be used only where the light› is under complete control, as in a ıdio. It cannot be used for outdoor ›nes where the natural lighting is high, ıce the cells are unable to differentiate ›tween the ambient light and the scanng beam.

The obvious need, therefore, is for me scheme whereby the image can be llected by a lens and projected on to suitable scanning device located at its cal plane (i.e., the position the film ›uld occupy in a conventional camera). ırly experimenters made many attempts produce such a camera, using mechical scanning systems, but they met th only limited success. It was not ıtil the development of electronic scanıg, and its application to the TV camı, that any degree of success was ach›ed.

In passing, it is interesting to note that completely electronic scanning system "Distant Electric Vision" was sug›sted by the English scientist. A. A. ımpbell-Swinton, as early as 1908 and ain in 1911 in greater detail.

Since electronic scanning is the basis all modern TV systems, it is worth nsidering in some detail. Those who familiar with the oscilloscope will be ›ll on the way to understanding the sic principles, and may with advantage ›er to Chapter 16 for a brief refresher.

Electronic scanning, at both transmitter and receiver, uses modified versions of the simple cathode-ray tube used in oscilloscopes. An ordinary cathode ray tube is normally made of glass, is roughly conical in shape, and has a screen of fluorescent material at the larger end. At the small end, and directed towards the screen, is a heated cathode wich produces a copious stream of electrons from its hot surface, in exactly the same manner as a valve. (See Chapter 6.)

By means of an electrode assembly known as a gun the electrons are concentrated into a narrow beam and directed towards the screen at quite high velocity. By varying the voltages applied to the gun the beam may be focused to a fine point bv the time it reaches the screen. It would normally strike the centre of the screen unless

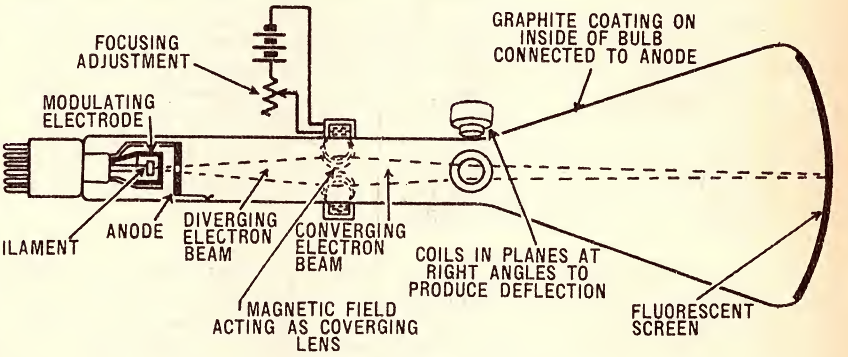


Figure 2. A cathode ray tube. As shown it is fitted for magnetic deflection and focus, but electrostatic focusing is often employed. In practice the deflection coils are larger and combined into a single unit called a yoke. A receiver picture tube has a much larger screen and is much shorter relatively.

otherwise deflected. (Figue 2.)

When the beam strikes the fluorescent material it causes the latter to emit light, the brightness depending on the rate at which the electrons reach the screen, and the colour on the material from which the screen is made. Almost any colour, or white, can be produced by suitable mixtures of screen materials.

To make use of this electron beam some means must be provided to deflect it to any part of the screen. In the smaller cathode ray tubes, such as used in instruments, the deflection system is built into the tube. Between the gun and screen are two pairs of deflection plates, one nominally horizontal the other vertical.

If a voltage difference is applied to either pair of plates, the beam will be deflected towards the positive plate. Thus the vertical plates will deflect the beam horizontally, and the horizontal plates will deflect vertically. To avoid confusion, the plates are usually referred to as "horizontally deflecting" and "vertically deflecting." This method of deflection is known as electrostatic, and is most useful in small tubes used in conventional oscilloscopes. It was employed in early TV systems, and still is to a limited extent, but has been almost entirely superseded by MAGNETIC DEFLECTION.

Magnetic deflection employs deflection coils mounted outside the tube and through which are passed suitable deflection currents. The magnetic fields which they produce deflect the electron beam. A complete deflection coil assembly is commonly called a DEFLECTION YOKE. Magnetic deflection has a number of advantages, particularly where large picture tubes are concerned.

In addition to the various focusing and deflecting electrodes, the tube is fitted with a control grid which functions in almost exactly the same way as its counterpart in a valve. Thus, by applying suitable values of negative voltage (relative to the cathode) the electron stream intensity may be reduced or even cut off completely, thereby varying the light intensity on the screen in a similar manner. This characteristic of the tube is most useful at the receiving end of the system.

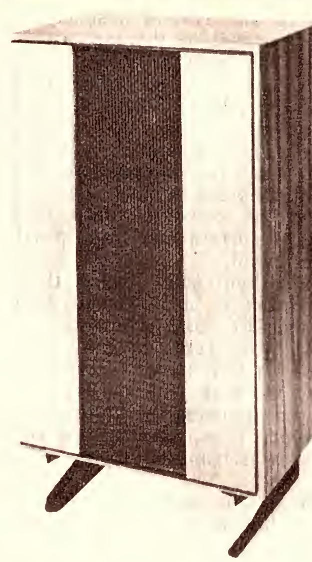
By generating suitable voltage or current waveforms, called SAWTOOTH waveforms, and applying them to the deflection plates or coils, we can cause the electron beam to trace out a pattern similar to the one we described using a spotlight. The advantage of the electron beam over the light beam is that the electron beam may be deflected virtually instantaneously. The light beam, by comparison, can only be deflected by moving relatively heavy optical elements, thus severely limiting the speed with which we may scan our picture. Alternatively, we would need prohibitively bulky and expensive mechanical systems.

Two sets of deflection signals are needed to produce the pattern we require. One set operates at relatively high frequency and is applied to the horizontal deflection components. This causes the beam to move from left to right across the screen at a steady rate, then return almost instantaneously to the left hand side and repeat the steady sweep. At the same time a lower frequency signal is applied to the vertical deflection components so that the beam is moved down the screen.

By suitably relating the two frequencies the beam is moved downward at a rate which allows the horizontal movement to trace out a series of lines one below the other. When the bottom of the screen is reached, both deflection systems return it quickly to the top left corner and the process is repeated. The pattern which is traced in this manner is called a RASTER.

In the Australian TV system, 25 complete rasters are traced out every second and a complete raster is known as a

AUDIOKEFMUSICIANSHHH....



THE KEF "CONCORD," reviewed in Hi-Fi News March '67

Shhh is the colourless, neutral sound of a perfect loudspeaker, reproducing electronically generated random noise — white noise. This is a very stringent test, which few loudspeakers can withstand. Most react by emitting a hollow gritty noise, indicating faulty transient response which blurs the music and tires the listener.

All **KEF SPEAKERS** are tested with white noise and those which fall short are ruthlessly eliminated. Shhh is the secret of KEF's quality and smoothness, in a word — LISTENABILITY.

The **CONCORD** is one of the few examples of near perfection in sound and this system will soon be available in Australia. So will be the startingly new and most exciting CRESTA and CARLTON systems introduced at the 1967 audio fair in London. These will suit other purses.

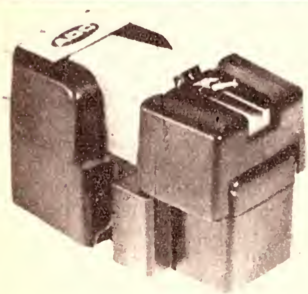
The CONCORD was introduced at the 1966 U.K. audio fair and Hi-Fi News Magazine (U.K.) reported then from London: "Aural centrepiece here was the new Concord speaker-system, a development of the Duette Mark II, which has been so upgraded, that a new name was called for. A number of cabinet and drive-unit refinements have produced a REALLY SUPERB SOUNDING SYSTEM, GIVING A LOVELY SENSE OF AMBIENCE ON KNOWN RECORDINGS. IT WAS VERY EASY TO FORGET THE SPEAKERS AND BECOME IMMERSED IN THE MUSIC. KEF WERE USING ADC PICKUPS."

In his review, R. L. West, most probably the most highly regarded speaker authority in England, says: "At the first moment of switching on, one realised it was an OUTSTANDING SPEAKER. Things felt real and alive, even at low levels . . . It was a pleasure to listen to the many tapes and B.B.C. programmes and hear really clearly once again . . . Listening is entirely without fatigue . . . Over a long period of listening nothing ever seemed to catch it out . . . The reviewer was so intrigued, that it was compared against a large number of speakers and the original judgement was not shaken in the least . . . Non-compromise response down to 45-50 Hz and still useful down to 30 Hz."

The CONCORD employs the famous KEF B139 Mark II and T15 Mark II units skilfully blended with a sophisticated seven-element printed circuit network to give smooth coverage of the entire audio range. The bass reproduction is quite astonishing from such a small enclosure. Organ pedal notes and the bass instruments of the orchestra are brought out with amazing clarity and weight, so that the Concord can be compared with the largest and much more expensive systems. The T15 Mark II tweeter is notable for its remarkable musical quality, reproducing massed violins and soprano voices with beguiling translucency.

WATCH FOR FURTHER ANNOUNCEMENTS

WHAT GOES IN MUST COME OUT



THE ADC-220 STEREO CARTRIDGE

For optimum performance you cannot possibly buy a more advanced pickup cartridge than an ADC and there is a large range to choose from for all applications. The secret of ADC cartridges and their unparalleled performance is the exclusive and patented INDUCED MAGNET PRINCIPLE, which slashed mass of the moving system to half or one-third that of other high-grade cartridges currently available. Find out more. AND IS THERE A BETTER AMPLIFIER THAN THE **ADC "SIXTY,"** A BETTER PICKUP ARM THAN THE **PRITCHARD MARK II** AND A BETTER TURNTABLE THAN THE **JH?** WHERE?

THE ADC "SIXTY" AMPLIFIER

J. H. REPRODUCERS PTY. LTD.

293 HUNTINGDALE ROAD, CHADSTONE, VICTORIA. TELEPHONE: 277-3066

Exclusive Australian Representatives of ADC, U.S.A. and KEF, U.K. and Makers of the J.H. Synchronous Turntable.

icture. This figure of 25 is higher than ıe minimum figure of 16 suggested arlier, and is necessary to minimise icker. It is also close enough to the ormal motion picture rate (24 pictures er second) to enable films to be scanned directly at 25 pictures with negliible difference to the rate of moveıent or pitch of sound.

But a presentation rate of 25 pictures er second is not sufficient in itself to educe flicker to an acceptable level. 'his problem is not peculiar to teleision; it is also encountered in motion ictures. In the latter case it is overcome y a simple modification to the shutter, /hereby each picture is presented twice, hus presenting the eye with a 48Hz licker rate rather than one of 24.

In TV systems the problem is overome by a technique called NTERLACED SCANNING, which is . variation of the simple scanning proess already discussed. In simple scanıing we assumed that the lines would e scanned in logical sequence, 1, 2, 3, ., etc., starting from the top of the picure. In the interlaced system we scan ll the odd numbered lines first, i.e., 1, , 5, 7, etc., then return to the top of he picture and scan the even lines, 2, 4, , 8, etc. Either one of these scans is alled a FIELD (Figure 3.)

Thus we fill the screen with half the otal light 50 times a second, rather than he total light 25 times a second. As far s the eye is concerned, it reacts almost exactly as if we had presented 50 comlete pictures per second, rather than mly 50 fields. At the same time we void the serious bandwidth complicaions which could result from trying to resent 50 complete pictures per second. What is meant by "bandwidth?" We hall explain the term a little later.)

The interlace function is not as diffiult to provide as might be imagined, ınd is mainly a matter of selecting suitıble transmission standards. One of these s the vertical scanning rate, which must e double the rate of complete pictures o be presented per second. Thus, to resent 25 complete pictures per second ve scan the picture vertically 50 times er second. The other requirement is hat the number of lines per picture nust always be an odd number, regardess of the actual standard selected e.g., 405, 441, 525, 625, 819).

The odd number of lines means that each field will involve an odd half line .e., for the 625 line system each field will consist of 312½ lines. The time ıeeded to scan half a line is also the ime needed for the vertical scan to move lownward by half the distance between he previously scanned lines, say the irst and third. Thus the second field interlaces the first field automatically.

So far all our references to scanning echniques have simply assumed that we can provide some means of keeping the scanning system at the receiver in step with the one at the transmitter, without offering any explanation. This process is called SYNCHRONISATION or, more commonly, SYNC. We will now consider this in more detail.

Synchronisation is achieved in practice by transmitting a regular pattern of pulses, called SYNC. PULSES, along with the picture information. Success of the system is based on the assumption that the receiver deflection circuits can quite easily be adjusted to run at approximately the frequency required and that this is all that is required if the pulses from the transmitter can be used to provide the final frequency correction and to adjust the phase. (Figure 4.)

There are two sets of sync. pulses, one for each of the deflection oscillators. To control the horizontal oscillator, a single narrow pulse is transmitted at the end of every line. This "instructs" the scanning oscillator to return the beam to the left hand side of the raster (RETRACE) and commence tracing a new line. During the retrace and scanning period the deflection oscillator is "running free," and subject only to its own frequency determining components.

To control the vertical oscillator a series of pulses are transmitted at the end of each field. They are broader than the line pulses and grouped close together, which enables the system to distinguish them from the line pulses. It does this by INTEGRATING (adding together) the pulses to make one large pulse, which then serves to "instruct" the vertical oscillator to retrace to the top of the raster and commence a new downward scan. As with the horizontal oscillator, the vertical oscillator "runs free" after being triggered by the sync. pulse.

The times during which the pulses appear at the end of each line and each field are called BLANKING PERIODS, and no picture, or VIDEO, information is transmitted during this time. The blanking periods appear as a black border around the picture. Thus by reason of their position, in time, the sync. pulses do not interfere with the picture information.

However, the reverse is not automatically true, and it is conceivable that video information could be "seen" by the synchronising circuits and mistaken for sync. pulses. This is overcome by presenting the video and sync. pulses at different levels. In the Australian, system, and most others, a peak white signal is represented by about 12 p.c. modulation, peak black by about 75 p.c. modulation, while the sync. pulses occupy the "blacker - than - black" region between 75 p.c. and 100 p.c. modulation. In the receiver, it is relatively easy to provide a circuit which will not respond to any signals lower than 75 p.c. but responds quite readily to values above this. Thus the sync. pluses are effectively separated from the video signal. This circuit is called a SYNC. SEPARATOR.

At this point, with our scanning and synchronising systems all nicely worked out, the reader may fairly ask how we use an electron beam to scan the image

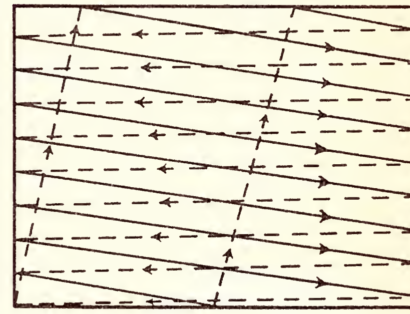


Figure 3. The pattern of interlaced scanning. Compare this with the pattern on page 61.

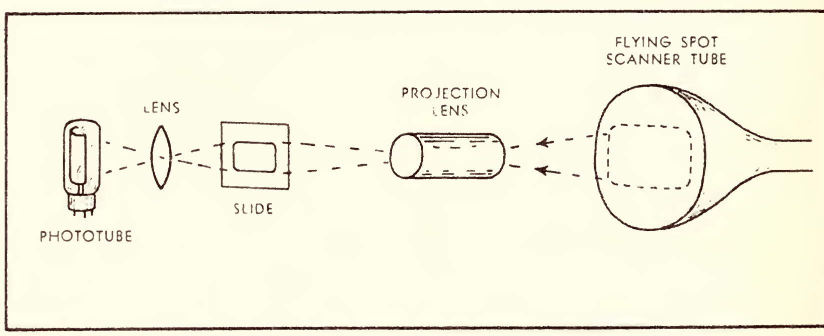
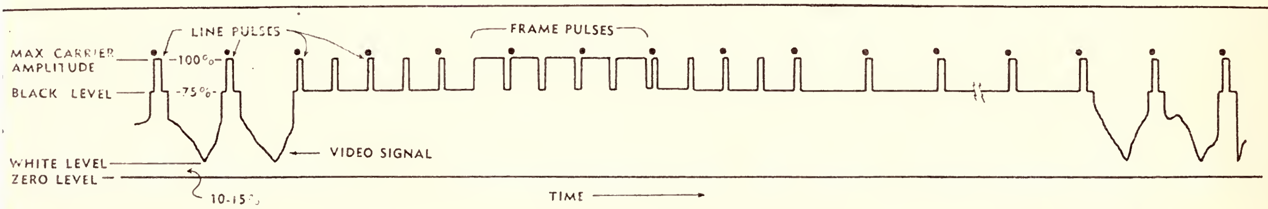


Figure 5. A simple form of electronic scanning. A raster traced on the tube face is focused on to a transparency and then on to a photoelectric cell. Output from the cell becomes the video information.

Figure 4. The relationship between video signal, line pulses and frame pulses. The five broad frame pulses are intergrated into one large pulse, while the spaces between them keep the line oscillator in step.



Homecrafts PTY LTD

AUSTRALIA'S LARGEST Radio, Television and Hobbies SPECIALISTS

307 ELIZABETH STREET, MELBOURNE – 60-1442

★ We have everything for the Radio Hobbyist ★

MODEL 200H

20,000 Ohms per Volt DC 10,000 Ohms per Volt AC.

Specifications:

DC Volt: 0-5, 0-25, 0-50, 0-250, 0-500, 0-2,500.

AC Volt: 0-10, 0-50, 0-100, 0-500, 0-1,000

DC Current: 0-50. Microamps res. 0-25, 0-250 Milliamperes.

Resistance: 0-60K Ohms, 0-6 Meg-ohms.

Capacity: 0-01-0.3mfd (at AC 5 volt 0.0001-01mfd at AC 250 Volt).

Decibel: minus 20db plus 22db.
Output Range: 0-10, 0-50, 0-100, 0-500, 0-1,000
Battery used: UM-3-1, 1 piece.
Dimensions: 3¼in x 4½in x 1⅛in.
Complete with internal battery, testing leads and prods.

PRICE $11.95
Including Sales Tax
Plus Postage, 35c.

Capacitor Substitution Box, 1,000 VW $5.50
Resistor Substitution Box, 1 Watt. Plus Post, 20c. $5.00

TRANSISTOR AERIALS

4in extends to 27in	$1.60
5in extends to 39in	$1.70
6in extends to 43in	$1.40
6in extends to 32in	$1.00
6in extends to 28in	$1.20
7in extends to 39in	$1.60
9in extends to 39in	$1.40
10in extends to 39in	95c

Plus Postage, 15c.

CRYSTAL SET BUILDERS

Coils	60c
Diodes	35c
Headphones	$2.50
Tuning Conds	$1.85
Terms .. .. Ea.	12c

Plus Postage.

TAPE RECORDER ACCESSORIES

2¼in spools	30c
3in spools	35c
5in spools	40c
7in spools	50c
2¼in x 100ft tape	45c
2¼in x 300ft tape	$1.20
3 in x 600ft tape	$2.25
5¾in x 850ft LP Tape	$1.50
5¾in x 1,200ft tape	$2.50
7in x 1,800ft tape	$3.95
5in Plastic Tape, boxes	60c
7in Plastic Tape, boxes	90c

Plus Postage.

KEW METERS

MR-2P 0-1 m/A	$3.65
MR-2P 0-50 u/A	$5.80
MR-2P 0-100 u/A	$5.30
MR-2P 0-500 u/A	$5.50
VR-2P V.U. Meter	$5.80
MR-2P Stereo Balance	$5.25
MR-2P 0-20v. D.C.	$4.00

All meters in white plastic case.

PIEZO PICK-UPS AND CARTRIDGES

PU-86 Pickup LP/78 T/O Crystal cartridge. Length 204mm .. .. Ea. $2.33

Y700 Cartridge. Mon LP/78 $2.00

PU-86 Pick-up Ster-LP/78. T/O Cartridge. Length 204mm .. .. Ea $3.65

Y200 Cartridge. ST. LP/78 .. $2.90

PU-54 Pick-up LP/45 only. Length 1.25mm .. .. Ea. $2.10

Y400 Cartridge. LP/45 .. .. $1.20

Sapphire Replacement Styli Each 30c

SUB MINIATURE

I.F. TRANS, 7 x 7mm
In sets of 3.
$3.20 per set.
OSC. COILS, 7 x 7mm
To match I.F. Trans.
$1.10 ea.

5K SUB-MIN POTS, w/switch. 65c.

CO-AX MIC. CABLE
Grey P.V.C. Cover.
15c yd **$14.50** 100yds.

STANDARD THIN MIC. CABLE
Grey P.V.C. Cover.
10c yd, **$9.00** 100 yds.

4c SHIELDED P/U FLEX
P.V.C. Covered, 25c per yd.

PIEZO MICROPHONE INSERTS

MC-3 Crystal. 50- 7K. 35 x 25 x 8 mm. -57DB.	$1.10 ea.
MC-7 Crystal, 100- 7K. 39 mm Round x 11 mm. -56 DB. ..	90c ea.
MC-8 Crystal, 50- 8K, 48 mm Round x 17 mm. -50 DB.	$1.80 ea.
MC-9 Crystal 50- 8K. 25 mm Round x 9 mm. -68 DB. ..	$1.80 ea.
MC-33 Crystal 50-10K, 33 mm Round x 9 mm. -60 DB. ..	$1.10 ea.
MD-5 Dynamic. 100-15K. 33 mm. Round x 14 mm. -55 DB ..	$1.80 ea.

TRANSISTOR SET ACCESSORIES

Magnetic Earpiece with 3.5mm Plug	75c
Crystal Earpiece with 2.5mm Plug	75c
Crystal Earpiece with 3.5mm Plug	75c
Jacks, 2.5 and 3.5mm	20c
3.5mm Plug and Cord ext. Jack Pair	50c
Metal Co-axial Plugs and line Sockets .. .. Pr	65c

"Din" and "Hirschmann," 2, 3, 4 and 5-pin Plugs, Chassis and Line Sockets, carried ex stock Prices on application.

P.M.G. type Plugs from	55c
P.M.G. type Jacks from	35c
P.M.G. Line Jacks from	55c

307 ELIZABETH STREET, MELBOURNE PHONE 60-1442

at the transmitter. One simple way is to use what is called a flying spot scanner, which has valuable, though limited, practical applications. In this arrangement the electron beam traces the raster on a fluorescent screen, exactly as in conventional cathode ray tubes. The screen is located behind a transparency of the image to be transmitted, and a photo-electric cell is placed in front of it. Thus the cell registers the amount of light passing through the transparency as each part is scanned, and the cell output becomes the video signal. (Figure 5.)

Naturally, this arrangement is limited to material which can be presented in transparency form and is of no value for "live" images collected by a lens. To scan these we need a very much more complex tube. A number of these have been developed, such as the ICONOSCOPE, the IMAGE ORTHICON, the VIDICON, and the PLUMBICON. It would be impossible to deal with all these basic types, and the variations on them, in a short article like this. However, a brief description of two of them may prove helpful.

A basic item in most picture tubes is an electrode which is referred to variously as a PHOTO-CATHODE, a MOSAIC SCREEN, a SIGNAL PLATE, or a TARGET. It commonly takes the form of a mica sheet several square inches in area and about .001in thick. One side is coated with a continuous film of metallic silver. On the other side are deposited countless particles of metallic silver which are oxidised and made light sensitive by treatment with caesium. The particles are quite separate and insulated from each other. (Figure 6.)

There is obviously a certain capacitance between each particle and the back plate, so that the mosaic, in effect, can be regarded as an assembly of countless tiny capacitors, with one common plate, and every other plate photo-sensitive. Under the influence of light, a potential difference tends to build up between each of the silver particles and the back plate. If an image is projected on to the photo-cathode by ordinary optical means, the individual tiny capacitors tend to acquire a charge proportional to the light and shade of the picture.

The function of the tube is to scan these tiny charges, converting them into picture signals.

One of the earliest form of picture tube was known in America as the "Iconoscope" and, in England as the "Emitron." (Figure 7.)

The photo-cathode is mounted in the main body of the tube. The scene to be televised is focused through an ordinary lens system on to the light sensitive surface. Under the influence of the light and shade, the tiny silver particles emit electrons and begin to acquire a positive charge. The charge continues to build up, according to the incident light, until it is ultimately released by the electron beam.

It is important to note that light falls on the photo-cathode all the time, and that the charging process by the minute capacitors is likewise continuous.

When the charge is ultimately released, it is quite substantial as a result, and this makes an important contribution to the sensitivity of the Iconoscope or Emitron.

Scanning is achieved by means of an electron beam generated in the neck of the tube. This beam is made to scan the surface of the mosaic, line by line in the manner already described. The precise effect of the electron beam on each tiny capacitor is rather complex, and a detailed examination is hardly warranted at this juncture. Sufficient to say that electrons from the beam replace those which have been emitted as a result of the photo-electric effect and discharge the tiny capacitors as it passes across them.

The resulting change in potential is naturally communicated to the common back plate and a voltage is generated across the load resistor "R." This is subsequently amplified, becoming the picture signal which modulates the transmitter. Primary and secondary electrons released from the photo-cathode are collected by a ring or metallic coating inside the body of the tube.

The most popular modern tube is the Image Orthicon. It has always been highly regarded, and the very latest versions are capable of superb results.

Physically the Image Orthicon looks rather like a projection display tube, being about 15 inches long and about four and a half inches in diameter at the head. It employs a single photocathode like the Iconoscope of Emitron, but transparent to light.

The basic principles are illustrated in figure 8.

Electrically, the Image Orthicon is divided into three distinct sections, an image compartment, a scanning section and an electron multiplier.

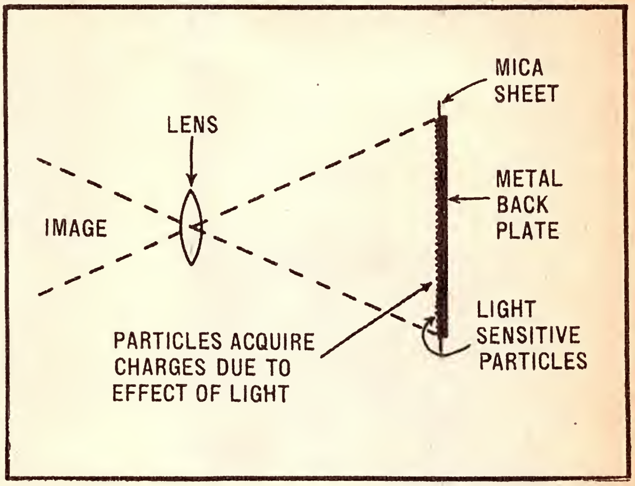


Figure 6. The heart of all camera tubes is some form of photosensitive mosaic. Each photo-sensitive element is small by comparison with an elemental area in typical systems.

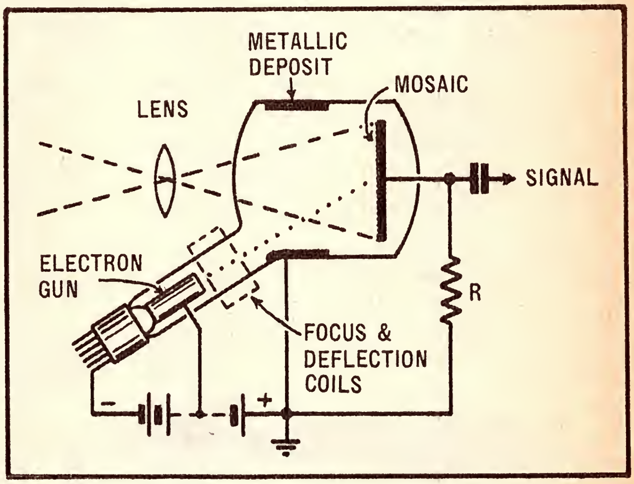


Figure 7. One of the first practical camera tubes, the Iconoscope. Note the angle of the electron gun which presented both optical and mechanical problems.

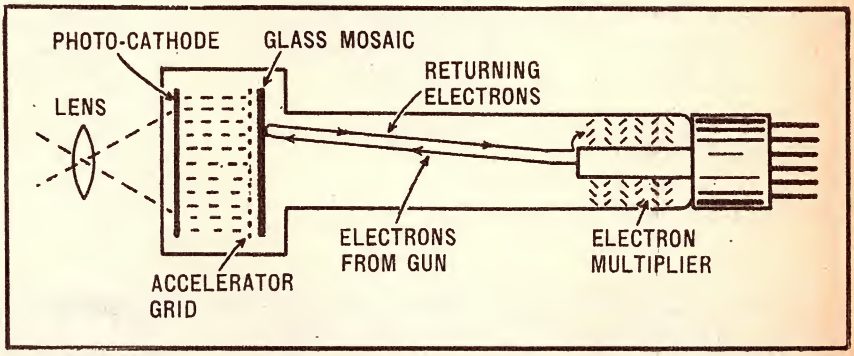
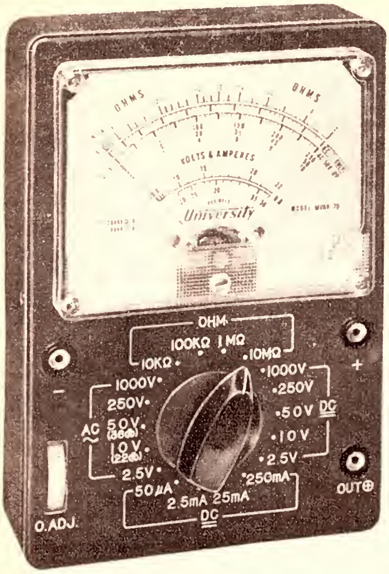


Figure 8. A simplified drawing of the Image Orthicon, one of the most popular camera tubes currently in use. Note the "in line" construction, which simplifies mechanical and optical design.

EVERYTHING FOR THE HOBBYIST & SERVICEMAN



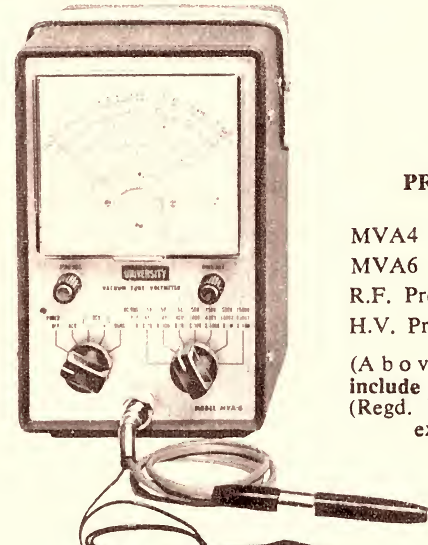
2 AMAZING "UNIVERSITY" INSTRUMENTS

MODEL MVA-4-General Purpose 20,000 ohms per Volt Multimeter

Brief Specifications:

D.C.V.: 2.5/10/50/250/1,000 (20KΩV)
A.C.V.: 2.5/10/50/250/1,000 (8KΩV)
D.C.A.: 50uA, 2.5mA, 25mA, 250mA
Ohm: 10K, 100K, 1M, 10M
db: −20, +22, +20, +36

Accuracy: ±3% for D.C. range
±4% for A.C. range
Size: 6" x 4 3-16" x 2⅛"



PRICES

MVA4 ..	$16.31
MVA6 ..	$47.25
R.F. Probe	$6.75
H.V. Probe	$9.00

(Above prices include Sales Tax. (Regd. Postage $1 extra).

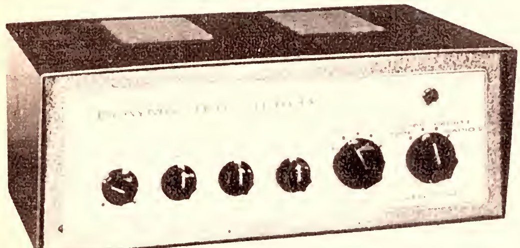
MODEL MVA-6-VACUUM TUBE VOLTMETER.

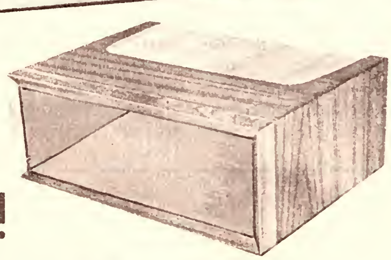
All "University" instruments are backed by full service facilities.

Brief Specifications:

A.C. Volts RMS—0—1,500 (in 7 steps)
Volts P—P—0—4,000 (in 7 steps)
D.C. Volts+and—0—1,500 (in 7 steps)
Ext' to 30KV with ext' Probe
Input res' 10 meg.
Ohms—.2ohms—1,000meg (in 7 steps)
DB—(ref' 1mW in 600Ω)
−20 to +65 (in 7 ranges)
Accuracy: ±3% for D.C.ranges
±5% for A.C. ranges
Size: 5½" x 9½" x 6"

PLAY SAFE---use only INSTROL components in your PLAYMASTER 115 AMPLIFIER





YES!

We can supply the **complete kit** for the 115, including metal case, and all best quality components precisely to "Electronics Australia" specifications.

CRYSTAL/CER'VERSION KIT OF PARTS	$95.00
BUILT and TESTED	$117.50
EXTRA FOR MAGNETIC SECTION KIT OF PARTS	$10.50
BUILT and TESTED	$12.00

Instrol components are all best quality throughout, and made accurately to the specifications laid down by "Electronics Australia."

INSTROL PRINTED CIRCUIT BOARDS.

To make component assembly easy, Instrol pre-fluxed printed circuit boards are clearly printed on the reverse side with a coded component location map. This corresponds with a separate component code sheet. No guesswork, every component must fall correctly into place. For the crystal/ceramic version 3 boards are required (2 amplifiers, 1 pre-amp). The magnetic version requires one additional magnetic pre-amp board.

PRICE: Crystal Pre-Amp .. .. $2.00 (plus postage 10c).
Main Amplifier, each .. .. $1.60 (plus postage 10c)
Magnetic Pre-Amp .. .. $1.60 (plus postage 10c).
Set of 4 .. .. $6.80 Post Free.

INSTROL METALWORK AND LABELS

The complete set of Metalwork comprises chassis with sub chassis and 2 brackets (cadmium plated and passivated) plus front panel and case (oven baked hammer tone duco) Labels are high quality anodised, either gold with black lettering or simulated white with brown lettering.

PRICE: Chassis, sub chassis, 2 brackets
and front panel (Less case) .. $9.19 (Postage Extra $1.00)
Case only .. .. $3.71 (Postage Extra 75c)
Complete set .. .. $12.90 (Postage Extra $1.40)
LABELS .. .. $2.00 (Postage Extra 10c)

KNOBS

Same as used on original, the set comprises 2 large and 4 small knobs.

PRICE. Set of 6 .. .. $1.28 (Plus 20c Postage)

TIMBER CABINETS

We have produced a beautiful timber case for the 115, similar to that used on the most expensive imported amplifiers. Available in Teak, Walnut and Maple Veneers.

PRICE: Teak .. .. $17.50 (Plus 50c Postage)
Walnut and Maple .. .. $16.50 (Plus 50c Postage)

BROADWAY ELECTRONICS PTY. LTD.

E.S. & A. BANK BUILDING, CNR. BROADWAY & CITY RD., SYDNEY
(Opp. Grace Bros.)
Phone: 211-4224, 211-4244, 211-4213

Light rays from the image are focused on to the transparent photosensitive mosaic. Electrons are emitted from the inner surface in proportion to the light and shade of the image. These primary electrons are accelerated away from the photocathode by an anode structure, and an extremely fine mesh-like grid, which carries a positive potential. The electrons pass through it at relatively high velocity and strike a second mosaic having high secondary emissive qualities.

The base for this second mosaic is actually a film of glass one-tenth of 1 mil. thick. It is so fine that it is transparent to electrons and the charges which accumulate on the front can influence or be influenced by electrons from an electron gun at the rear. When electrons strike the front of the glass screen they create on it an electron image, equivalent in density to the visual image on the photocathode. The impact of these primary electrons causes secondary emission, and individual particles of the mosaic acquire varying positive charges as a result.

The rear of the glass target is scanned by a low velocity electron beam, the electrons being slowed down just before they reach the rear surface. The beam gives up just enough electrons to neutralise the positive charges at each point of the mosaic, and the remainder of the electrons immediately reverse direction and return to a structure surrounding the gun. This structure is actually a form of electron multiplier which greatly amplifies the variations in electron current from the target.

The Image Orthicon combines the outstanding features of all previous tubes and the result is a tube of high sensitivity and small size. The Image Orthicon also puts the gun, the mosaic and the image all on the same axis and eliminates the need for the obliquely mounted neck, as in the Iconoscope and Emitron. It avoids problems with trapezium distortion, clears the lens mount and makes possible the use of a lens turret.

Another type of tube in common use is the Vidicon. This is normally a small tube, about 1in diameter, and is used extensively where the physically small camera and lens with which it can be used are of greater importance than some other factors. It also has the advantage of low first cost and relatively long life. On the debit side it suffers from limited definition and sensitivity and a tendency under low light conditions to retain an image for longer than is desirable, giving rise to smear on rapidly moving objects.

In spite of these disadvantages it has found use in industrial and educational applications as well as in TV stations, where it is useful for presenting captions, films, etc. A more recent version of this tube, called the Plumbicon, has eliminated a lot of the Vidicon problems, and is currently finding a wide application, particularly in colour cameras.

Now that we have learned something of the practical aspects of scanning and camera tubes we are in a better position to consider typical standards as used in modern TV systems. Earlier, we introduced the "elemental area" concept. It is important to retain this concept, even though the subsequent discussion may have placed more emphasis on "lines" than "areas."

The number of lines in a (horizontally scanned) picture determines the vertical resolution only. Horizontal definition is a function of how many transitions from black to white can be accommodated in a single line. As a rough approximation we may consider that, for a square picture, we need as many elemental areas per line as there are lines in the whole picture.

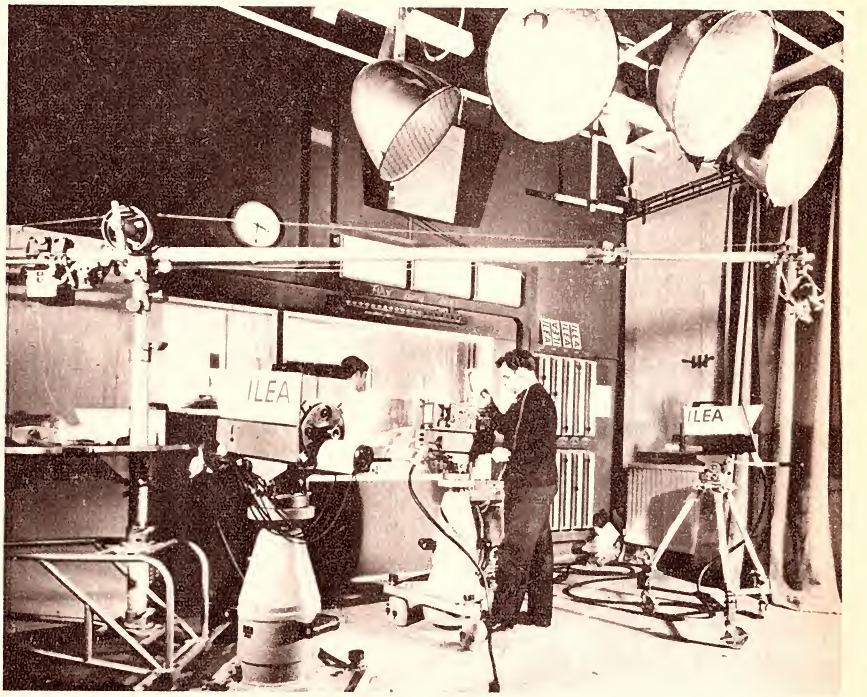
As an example, consider Australia's 625 line system. Allowing for lines lost during the blanking period at the end of each frame, we have about 590 actual lines in each picture. Since the picture is wider than it is high by the ratio 4:3 we should provide 590 x 4:3, or about 790, elemental areas in each line. Multiplying this by the 590 lines we get about 460,000 elemental areas per picture.

What governs the number of elemental areas which we can provide in one line? In simple terms it is a function of how rapidly we are able to switch the picture tube electron beam on or off representing an abrupt transition from black to white. The electron beam itself will respond at almost any speed we like to nominate, the real limitation being the signal we apply to it. This, in turn, is limited by the high frequency response, or BANDWIDTH, of the entire system.

In the example just cited we have 460,000 elemental areas in one picture, which we must transmit completely 25 times a second. Thus we have to transmit 460,000 x 25, or about 11.5 million, elemental areas each second. If we consider the extreme case where adjacent elemental areas are alternately black and white it can be shown that we can transmit two elemental areas per cycle of video signal. So, to transmit 11.5 million elemental areas per second we would need to transmit 5.75 million cycles per second (5.75 million Hz or 5.75MHz).

Transmitting a signal of this kind presents a number of problems. First we have to provide a carrier frequency high enough to accommodate such an order of modulation, which must be at least several times the modulating frequency. This fact, plus the space which such a signal must occupy, automatically dictates nothing less than the VHF bands, from about 50MHz to 300MHz. Even here spectrum space is precious, and every effort is made to reduce the needs of the TV transmitter as much as possible.

One trick is to employ a form of single sideband transmission (VESTIGIAL SIDEBAND), where as much as possible of one sideband is suppressed. Another is to accept some compromise between the number of elemental areas we would like to transmit and the minimum number which will noticeably degrade the picture. In the Australian system we provide a total bandwidth of 7MHz for each TV channel, which has also to accommodate the sound channel.



Modern television systems play many roles apart from entertainment. Industry, research, medicine and education all make extensive use of this facility. The picture shows a studio belonging to Britain's Educational Television Service, designed to serve 1,300 centres in inner London.

Within this we provide a video bandwidth of about 5MHz, which is only a little less than the theoretical ideal. However, this order of performance is seldom matched by the receiver, which would be regarded as quite good if its bandwidth extended to 4MHz. Nevertheless, the end result from a good TV set can be very satisfying if the original material is good.

Other systems vary from this standard. The American 525 line system has both less lines and less elemental areas, so must be regarded as marginally inferior, even though this may not be really serious in practice. On the other hand, some European 625 line systems are better than the Australian system, in that they provide a greater bandwidth and therefore come closer to reproducing an ideal number of elemental areas.

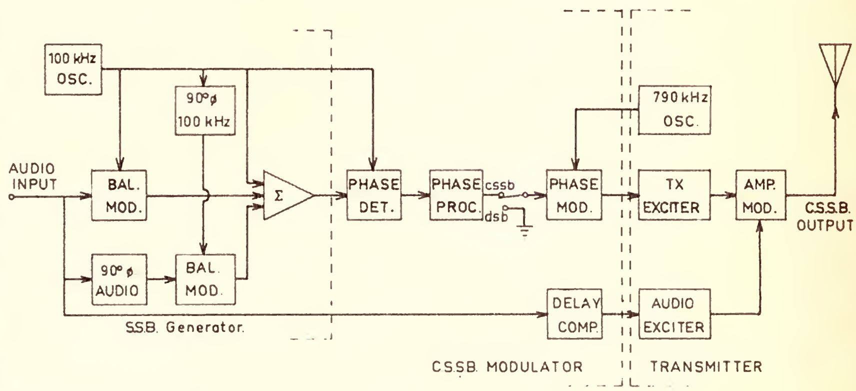
This covers most aspects of TV transmission and is all we can discuss in this chapter. In the next chapter we will decribe the other end of the link, the receiver.

COMPATIBLE SINGLE-SIDEBAND MODULATION --tests over station 4QG

In his "Broadcast Band News" on page 149 of our last issue, Authur Cushen referred to tests on compatible single sideband modulation, conducted on the standby transmitter of station 4QG in Brisbane. The following note by Mr. M. P. Moody, who was responsible for the tests, explains the basis of the system employed.

A research program was undertaken at the University of Queensland to study Compatible Single Sideband Modulation with a view to a practical system which could be adopted to a transmitter for broadcasting. After the initial tests on a model system had proved the feasibility of CSSB broadcasting, an approach was made to the P.M.G. and the A.B.C. requesting their co-operation. These departments readily made available their transmitter and program recording facilities for the tests.

The model CSSB system was modified to enable audio frequencies up to 10KHz to be used, and this was connected to the 4QG standby transmitter as shown in the diagram. The output power of the transmitter is 2KW and its frequency 790KHz.



University of Queensland Compatible Single Sideband System

The CSSB modulator consists essentially of a phase modulator. The phase-modulating signal is derived from the audio signal in such a way that when the **resultant phase-modulated** carrier is amplitude modulated in the usual way, a single-sided spectrum is obtained, which has a bandwidth approximately equal to that of the audio signal. Since a form of amplitude modulation is used, the signal can be detected with an ordinary linear diode envelope detector, and is thus "compatible" with existing broadcast receivers.

The phase modulating system is produced by generating a full-carrier single-sideband signal (which has envelope distortion), then limiting this and detecting its instantaneous phase. This phase signal is then processed and used to phase-modulate the transmitter carrier. The carrier is derived from the transmitter's exciter, and hence is crystal-controlled at the correct frequency. By switching off the phase-modulating signal, an instant changeover from CSSB operation to D.S.B. (double sideband) operation can be achieved.

The on-air tests were designed to compare the quality of reception of DSB and CSSB. Since the envelope is imposed in both cases by the same amplitude modulator, they are identical and exact. The only difference in the transmitted signals is their spectra. A difference in reception quality will occur however, due to the influence of the receiver filters in the RF and IF stages.

Two different effects occur. Since most commercial radios have IF bandwidths of about 10KHz, only 5KHz audio will be received using DSB. However, with CSSB, since the bandwidth is approximately equal to the audio bandwidth, a receiver with 10KHz IF bandwidth will receive audio frequencies up to 10KHz.

Thus, it is seen that for most receivers, a gain in fidelity is possible with the use of CSSB, with an accompanying increase in the quality of reception. The other effect involves the shape of the IF filter. If a DSB signal is passed through a filter **symmetrical** about the carrier (not necessarily flat over its band), no distortion of the envelope will occur, only a change in modulation depth. However, if CSSB is passed through a filter which has not a flat response, some distortion of the envelope will occur.

However, since the passband in most receivers is not symmetrical, some distortion of the envelope in DSB reception will be present, tending to reduce the disadvantage which CSSB exhibits in respect to DSB due to this effect.

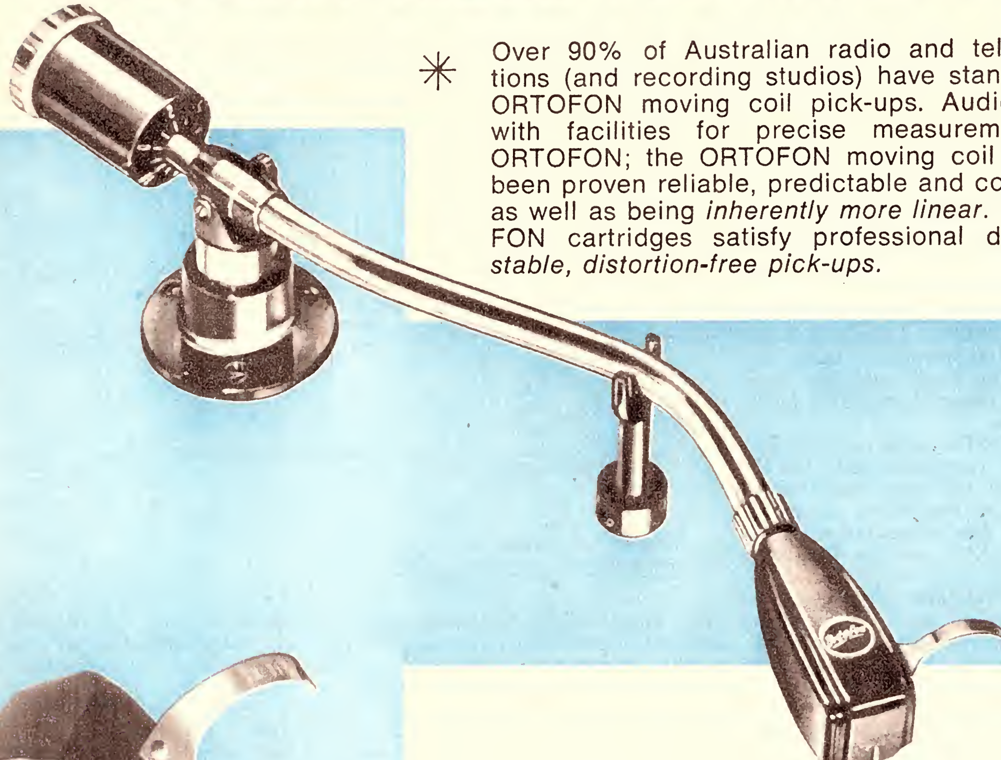
Thus there are two effects of the receiver filter, one improving the reception of CSSB compared with DSB, and one degrading it.

Each broadcast consisted of one hour of selected music played after midnight on eight occasions. This hour was split into two separate half-hour tests. In each test, 15 minutes of each type of modulation was transmitted, the listener not knowing the order in which each was used. In this way listener bias was eliminated. The listeners were then invited to choose which part of each test they preferred, and the reasons for choosing it, and in this way an indication of the comparision between the two systems was gained.

The results were very encouraging, and it can be said, with about 95 per cent certainty, that CSSB reception was as good and probably better than DSB reception. With its bandwidth-saving advantage, it thus appears that CSSB could be a worthwhile solution to some of the interference problems being experienced in Australia today.

ORTOFON

WORLD LEADERS IN TONE ARM AND CARTRIDGE TECHNOLOGY!



✳ Over 90% of Australian radio and television stations (and recording studios) have standardised on ORTOFON moving coil pick-ups. Audio engineers with facilities for precise measurement specify ORTOFON; the ORTOFON moving coil system has been proven reliable, predictable and consistent . . . as well as being *inherently more linear.* Only ORTOFON cartridges satisfy professional demands for *stable, distortion-free pick-ups.*

The audio enthusiast seeking the ultimate in high-fidelity reproduction can purchase ORTOFON arms and cartridge with complete confidence for **the most realistic high-fidelity sound originates with ORTOFON.** The new ORTOFON S-15 series cartridge has been acclaimed by critics all over the world. Tracking angle is precisely 15° and the most complex wave form may be traced at 1½ grams stylus pressure; the superbly polished elliptical diamond stylus is fully protected should the cartridge be accidentally dropped to the record surface.

Specifications —

- **Frequency response:** 20-20,000 Hz. $\pm$ 2 dB.
- **Static compliance:** 20 x 10^{-6} cm/dyne.
- **Channel separation:** 20-30 dB.
- **Stylus:** 0.0007 x 0.0003 elliptical diamond.
- **Equivalent mass:** 0.9 mg.

The ORTOFON elliptical diamond stylus closely approximates the shape of the original cutting stylus, and will track without distortion due to pinch effect . . . this freedom from distortion being obvious towards the label where pinch effect is always a problem.
Illustrated is the popular SMG-212 tone arm fitted with the "G" shell. ORTOFON tone arms are available in nine models. When the open-front metal "G" shell is used any cartridge may be fitted.
We invite you to listen to ORTOFON today at your favourite hi-fi supplier; listen to the astounding difference!

Australian National Distributors:

Simon Gray Pty. Ltd.

Head Office:
28 Elizabeth Street, Melbourne, Vic.
Tel. 63 8101*

Sydney Office:
22 Ridge Street, North Sydney, N.S.W.
Tel. 92 3890

INTERSTATE REPRESENTATIVES.

S.A.: Eilco Sales Pty. Ltd., 7-9 Osmond Terrace, Norwood, S.A. Tel. 63 4844
Q'land: Sydney G. Hughes, 154-158 Arthur St., New Farm, Brisbane. Tel. 58 1014
W.A.: Athol M. Hill, 613-615 Wellington Street, Perth. Tel. 21 7861
Tas.: K. W. McCulloch Pty. Ltd., 109 York Street, Launceston. Tel. 2 5322
A.C.T.: Australian Physical Laboratories, P.O. Box 225, Canberra City. Tel. 4 3010 (Mr. J. E. Howe)
N.T.: Pfitzner's Music House, Smith Street, Darwin. Tel. 3801

Forum

Radioactivity — Tape frequency response

In the brief period which has intervened between the last issue appearing on the streets and the preparation of this present article, there has been no further light on the question raised in Forum under the heading "Cold-cathode tubes —radioactivity hazard?"

Conducted by the Editor

Among the many who have expressed interest in the matter was a reader who took the trouble to ring from interstate. He confirmed that training in the Armed Services laid a good deal of emphasis on the hazards of radioactivity and agreed that this emphasis may well have been responsible for a gross exaggeration of the danger (if any) from radioactivity in small thermionic valves. But while he was apparently inclined to this view, he was certainly far from being sure of himself.

And, from Goondiwindi, Queensland, a correspondent, L.B., writes in the following terms:

Dear Sir,

"I refer to the item 'Radioactivity hazard' in Forum for the June issue. I have read much on this subject. Other hazards are X-ray radiation from operating EHT rectifiers, beta radiation from cathode-ray tubes and poisoning from contact with sulphides from domestic fluorescent tubes.

"My big criticism is that no one has, as far as I know, bothered to give details or symptoms of effects of this type of injury.

"In 1952 I was badly cut by a fluorescent tube and, having read a warning about such an injury, I consulted a doctor. He was as well advised about it as you are!

"In consequence, I developed a skin disease which was diagnosed as psoriasis. However, all agree that it doesn't fit the usual pattern but there is one factor which proves it is psoriasis—it is incurable!

"I feel that there is room for continuation of this article. How about a statement from the Armed Services?"

I reprint this letter even though, in terms of the immediate subject, it contains certain "red herrings." It does, however, relate the subject to human values.

First and foremost, radiation from EHT rectifiers and cathode-ray picture tubes has been the subject of considerable observation and discussion. Nor is it just a question of guesswork or opinion; the strength of such radiations can be measured and evaluated. By those who have done so, there appears to be common agreement that the radiation level from ordinary monochrome television receivers is of such an order, relative to the ambient, that it can pose no likely hazard to anyone, from viewers to TV servicemen alike.

The radiation from colour television receivers is a little higher, by reason of the increased EHT, but still well short of the danger level in domestic situations. Again, this has been the subject of considerable observation and, just recently, certain receivers in the U.S. were recalled for modification—just in case.

As for the alleged connection between a broken fluorescent tube and psoriasis, I am not competent to pass an opinion, or on whether there is a further connection between the substances used and the original subject of radioactivity. It may well be that, in toto, the hazard from a broken fluorescent tube is far greater than from radio valves of any description. A fluorescent tube is certainly larger, more fragile and more liberally coated with fluorescent powders.

To change the subject, I received recently an interesting letter from Mr Harvey Gernsback, publisher of the American magazine "Radio Electronics." The letter is self-explanatory:

Dear Mr Williams,

"In reading the April issue of your always interesting journal, I noted in your department 'The Answer Man Explains' a discussion about the fidelity of long-playing tapes. I missed the original discussion in your January issue.

"There is a small difference in high frequency response between the standard and so-called extra-play tapes, but there is a very marked difference between the response of standard tapes and the triple-length tapes, as you can see from the specification sheets which the 3M Company puts out here in the States. Since their tape specifications are pretty generally followed by other manufacturers, I presume that they probably apply in Australia, too.

"The Scotch brand standard tape is No. 111. Their long playing is either 150 or 190, depending on whether it has an acetate or polyester backing, and their type 200 is a double-length tape. The electrical characteristics of the 150, 190 and 200 are substantially identical and show a high frequency sensitivity approximately 3dB greater than the standard tape. This assumes that the bias of the recorder has been readjusted to optimum bias for these tapes. If the bias is adjusted to the optimum for the 111 tape, the electrical response of the 150, 190 and 200 will be substantially the same as 111.

"On the other hand, with the 290 triple length tape there is an 8dB difference in high frequency sensitivity,

Technical writing

Further to your Editorial, "ELECTRONICS Australia", May, 1967.

The low standard in technical writing is not confined to higher echelon professional engineers.

After multiple attempts at digesting the contents of numerous manufacturers' equipment handbooks, the brainchild of the so-called "Technical Writer," one inevitably reaches the conclusion that the majority of these gentlemen are non-technical and illiterate to boot!

E.W. (Carlton, N.S.W.)

regardless of whether the bias is adjusted for the 111 standard tape or for the 290. According to 3M, the 290 tape was not designed to be used on wide-range equipment but rather was designed for popular priced equipment, and its exaggerated high frequency reponse is supposed to compensate for inadequacies in high frequency response of the cheaper recorders. On a high quality machine it is very difficult, if not impossible, to adjust to flat response with the 290 tape since you tend, as your correspondent suggests, to get a peak response at around 10kHz.

A Younger Reader

From one of our younger readers omes a letter setting out the problems f junior but avid enthusiasts and reuesting circuits for devices using bat- ery valves. We quote:

Dear Sir,

"I am aged 13½ and very interested in radio and electronics. In 1965 I entered a project in the Science and Talent Search conducted by the Science Teachers' Association of Victoria. I named the project 'The Development and Construction of My Crystal Set,' and won a prize of $4.

"I have repaired several crystal sets, which were given to me when out of order, and have repaired quite a few electrically operated toys for my friends, also a transistor radio which had a broken resistor and a broken condenser lead.

"But, as a member of a family of eight children I find it hard to buy electronic parts. By saving up for a long time and with dad's help, I managed to get a Philips EE20 kit for Christmas and have had lots of fun with it, and still do.

"But I would like very much to get more gear to work with, so that I can learn about electronics. Sometimes I am lucky enough to collect old battery and AC radios and dad gets me some, too. I have dismantled most of them and saved lots of parts.

"Dad lets me use his Scope soldering iron and multimeter. I am not yet allowed to make any AC mains projects but am allowed to use two Philips battery eliminators, so far only when dad is around — I hope to be 'promoted' later on.

While I have saved all the parts I can, some of them are hard for me to work out. Sometimes valve numbers are rubbed out and the impedances of loudspeakers and transformers are missing. I have no way of testing these items. The manufacturers should brand them properly. Coil kits are a problem, too.

"Besides making up all the projects possible with my Philips kit, some of them many times, I have built a one-valve radio, from your 'Reader Built It' in October, 1956; a Morse-code oscillator from a circuit in a library book; a three-valve radio described in your magazine for February, 1953. All of these used battery valves.

"I have looked all through dad's collection of 'R, TV and H,' and 'ELECTRONICS Australia' magazines from January, 1959, along with odd earlier ones, but I cannot find enough battery valve projects. So I have been looking for them in the Warrnambool Library, but the projects from England do not always give details about the coils. I would like to see more projects in 'ELECTRONICS Australia' for battery valves."

P. R. (Warrnambool, Vic.)

One of the pleasing things about this letter is the natural reference to "Dad." In an era when so many voices are proclaiming a rift between generations, it is refreshing to observe situations where the old-fashioned relationship is maintained.

Again, the young correspondent's struggle to find parts and circuits strikes a familiar chord. In our relaxed moments, Associate Editor Phil Watson and I reminisce occasionally on the way we had to "scrounge," as country schoolchildren—not forgetting those medicine bottles which were "doctored" to become the containers for a battery of Leclanche cells. I wonder how they would go in a modern wall-to-wall home —those bulky generators of volts and green slime?

What happened to all the battery valves and to sets and circuits using them?

Answer: They were abandoned—more swiftly than any other electronic technique that I can recall.

The fact is that valves designed to operate from batteries never were anything but a precarious compromise between performance on the one hand and economy of operation on the other.

With the appearance of transistors and the rapid postwar proliferation of AC power mains designers dropped battery type valves like the proverbial hot potato and the public seemed to discard receivers using them in like manner.

Our readers certainly reflected a complete lack of interest in battery-valve circuits, simply on the basis that they could buy transistors for the same kind of money that they would otherwise spend on batteries.

The question of manufacturers branding individual components in their receivers is an old one and any remarks we might make on the subject are not likely to change the position to any degree.

First and foremost, manufacturers don't make their sets to be stripped down and one can hardly blame them if they don't pay too much attention to the desires of people who may later want to use the parts. If there is a point here, the people to consider would be servicemen, who have to identify parts for replacement purposes.

A fundamental fact is that equipment manufacturers do not buy parts "over the counter," identified and/or packaged for individual sale. They order by the hundreds or thousands, and there is usually a definite saving in buying parts packaged in bulk, with a minimum of external coding. Ordinary stock and assembly-line procedures avoid difficulties at the factory and it is only later that problems of identification arise.

Even then, it is much easier for a serviceman to order "Part No. 1234" than to quote a model and serial number and try to identify the component from it that he needs.

In short, while not defending inadequate identification, or type numbers that rub off, we have to point up the difference between parts offered for sale and those used in manufactured equipment.

"NEW LOOK" FOR THE EVER-POPULAR UNIT-4

For over five years, since May, 1962, the "Unit Playmaster No. 4" has been a sales leader among kits—a single unit stereo amplifier with excellent performance, full tone control facilities and a power output of about 10 watts per channel. With minor revision to its controls and its input and output facilities, it can take its place alongside the most modern solid-state equivalents.

By Leo Simpson

Two months ago, when we set about resenting the "All-Silicon Playmaster 15," we made no secret of the fact that s specifications were patterned on those which had proved so popular with the riginal No. 4 Unit Playmaster; sensi- ivity to operate from good quality eramic pickups, full control facilities, ood performance, a power output of bout 10 watts per channel, straight- orward construction and a general eco- omy of design. The 115 met these re- uirements, within the framework of resent-day solid-state techniques, with he option of an in-built preamplifier or low-output magnetic pickup cart- idges.

But the release of a solid-state ampli- ier does not, by any means, indicate hat valve amplifiers have "had it." For ll practical purposes, the performance igures of the basic No. 4 valve design re the same as those for the solid-state ersion. It can have the same control nd intput/output facilities, will fit into he same size case and can, if necessary, e provided with a similar preamplifier or magnetic pickup cartridges. To be ure, valves aren't quite as modern as ransistors, and they operate at higher emperatures but, against this, many en- husiasts will find this amplifier some- what easier and cheaper to build than he 115 all-silicon design.

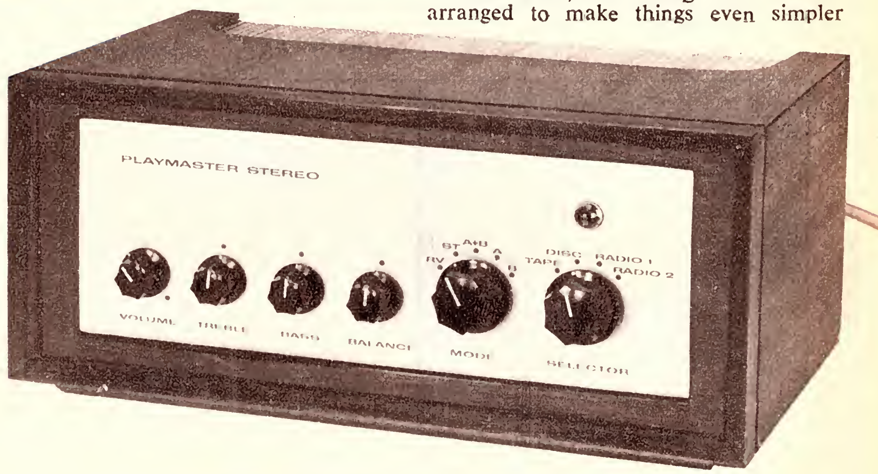
In fact, it is not our purpose to try o "sell" one design or the other. On he contrary, we have quite deliberately rranged for them to be virtually iden- ical in external appearance and per- ormance. Those who are looking for a olid-state design, with its air of mod- rnity, will naturally choose the 115. Others, who may prefer to stay with the echniques they understand better may refer the new 118, as we have designated he restyled No. 4. The comparative osts will be something for suppliers to work out and advertise, though we ex- ect the valve unit to be the cheaper f the two, at least for the time being.

The restyling is largely a matter of hysical arrangement. The old "selector" witch, popular a few years ago, has een replaced by two switches, one to elect the signal source and the other o select "mode" — a variation largely rompted by the possible use of ampli- iers with mono/stereo tape-recorders. This new control facility, requiring an xtra knob, obviously calls for a new anel, the layout being the same as for the 115 and the transistor control unit which preceded it.

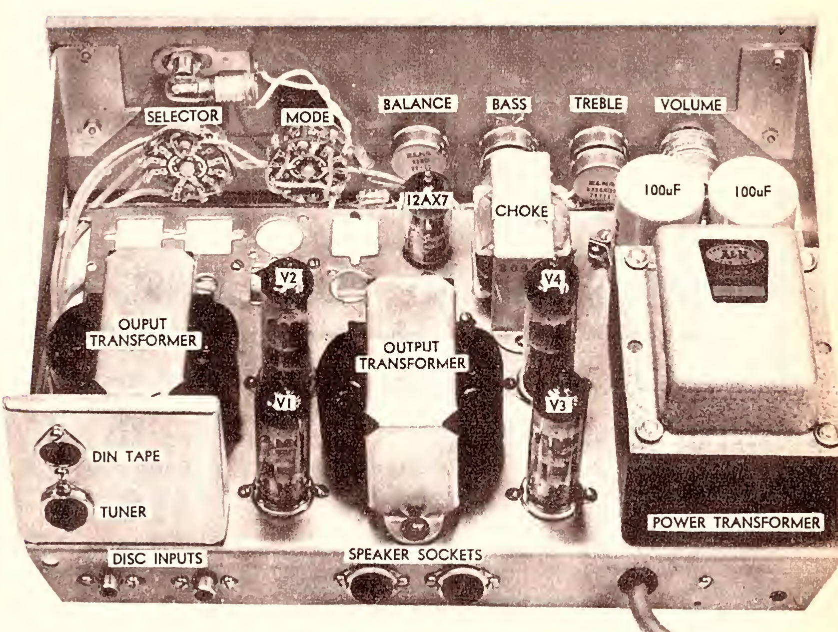
Behind the panel, the components have been laid out on the same chassis as is standard for the 106 Playmaster tuner/amplifier. Use of the same chassis is intended to assist the parts suppliers and the space not used for a tuner is available for a solid-state magnetic pick-up preamplifier, should this be required.

At the rear of the chassis, we have rearranged the connection facilities to provide for tape input/output, as well as for pickup and radio tuner.

Underneath, the wiring has been re-arranged to make things even simpler



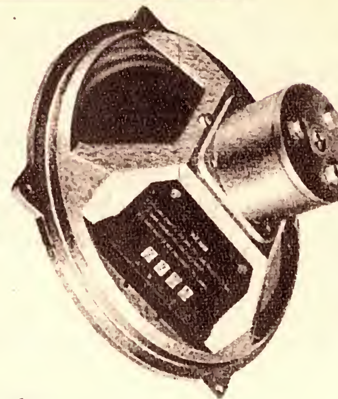
A front view of the new 118 Playmaster, fitted with a full-size panel and housed in a teak case, both available from one of our advertisers. These could be used for the 115 all-silicon unit featured in the May issue, alternatively, the new 118 can as easily be housed in a metal case, the two being quite interchangeable.



A rear view of the 118 Playmaster, constructed in the chassis originally designed for the popular 106 tuner/amplifier. The vertical bracket in the left foreground carries the DIN plugs for radio tuner and tape input/output. Constructors not requiring these facilities may prefer to omit them for the time being, but we suggest that the adjacent output transformer be moved forward slightly—just in case!

MAGRATH'S

Stentorian SPEAKERS



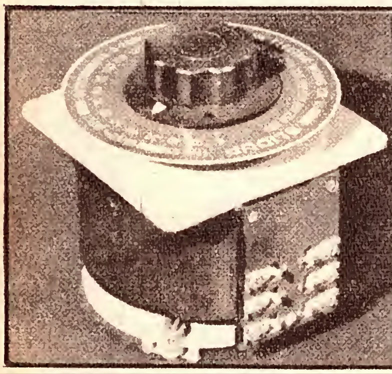
Model H.F. 1016 STENTORIAN
10in P.M. Unit and 16,000 gauss magnet. Universal impedance speech coil at 3, 7.5 and 15 ohms. Capacity 10 watts. Frequency response 30 c.p.s. to 15,000 c.p.s. Bass resonance 35 c.p.s. **$21.00** (including sales tax).

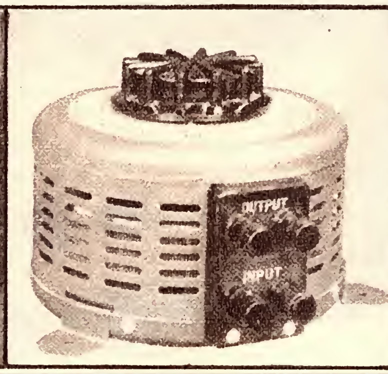
Model H.F. 1012 STENTORIAN
10in Unit 12,000 gauss magnet. Universal impedance speech coil at 3, 7.5 and 15 ohms. Capacity 10 watts. Frequency response 30 c.p.s. to 14,000 c.p.s. Bass resonance, 35 c.p.s., **$14.00** (including Sales Tax).

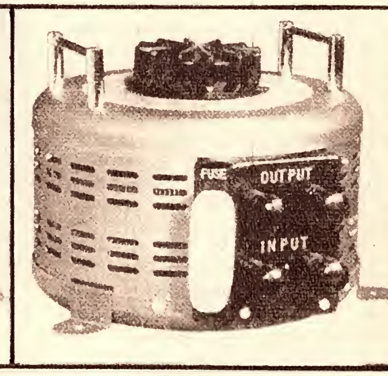
Model T.10 STENTORIAN TWEETER
Speech coil is aluminium wire wound on an aluminium former rigidly fixed to an aluminium diaphragm. Giving high standards of reproduction when used with Stentorian H.F.1012 and H.F.1016 speakers. Speech coil impedance: 15 ohms. Response: 200/15.000 c.p.s Flux density: 14,000 gauss. Capacity: 5 watts **$16.00** (including Sales Tax).

CROSSOVER NETWORK
W/B Crossover is of the filter type and is fitted to all the Duplex Loudspeakers. It is available for use separately, the 3.000 c/s type is half section series connected having an attenuation of 12 dB per octave. C.X. 3000, **$6.50** (including Sales Tax).

***POST FREE** anywhere in Australia*







VOLTAC FORMERLY 'SLIDUP' Variable Autotransformers

TYPE	In V	Out V	Current	CAP. VA	PRICE Sales Tax Extra
P1 Panel Mounting	230	0.260	0.5 Amps	100	$8.80
BP3 "	"	"	1.5 Amps	300	$14.60
BP5 "	"	"	2.5 Amps	500	$17.25
SB5 Bench Mounting	"	"	5.0 Amps	1000	$23.40
SB10 "	"	"	10.0 Amps	2000	$45.25
B15 "	"	"	15.0 Amps	3000	$53.10
B25 "	"	"	25.0 Amps	5000	$99.50

Sales Tax where applicable 12½%. (FREIGHT EXTRA!)

ALL THE ABOVE ARE AVAILABLE IN 3-PHASE COMBINATION. PRICES ON APPLICATION.

MAGRATH'S FOR ALL "ELECTRONICS Australia" PROJECT KITS

VARI-TACH Motor speed control project kit

Further details—Page 43, March '66 "ELECTRONICS AUSTRALIA"

Using this easily constructed, low-cost unit the speed of a "universal" or communator-type AC motor may be adjusted over a wide range while still maintaining fairly constant torque. Ideal for controlling speed of electric drills, saws, food mixers, projectors, etc.

$21.75
COMPLETE AND POST FREE
Anywhere in Australia and territories.

Model train control kit with SIMULATED INERTIA

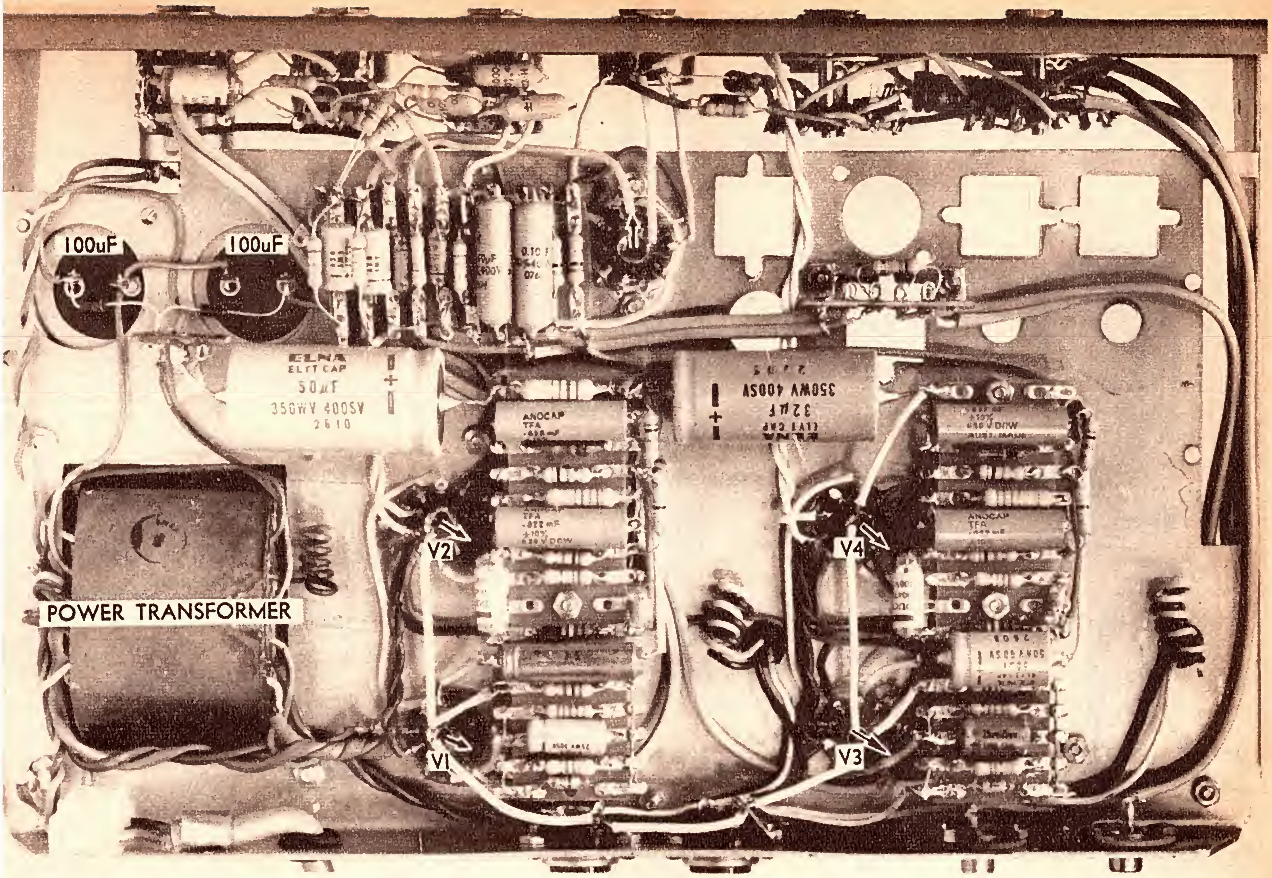
Further details—Page 80, March '67 "ELECTRONICS AUSTRALIA"

$14.75
SALES TAX AND POSTAGE PAID

It offers all the advantages of the simple thyristor controller, together with circuitry which makes the model perform just like a real train.

Panbrake Bench Mounting Metal Folder, $19.50 plus 12½% sales tax
Postage: Within Vic. $1.25, Within N.S.W., Tas. & S.A. $1.80, Elsewhere in Australia $2.60.

J. H. MAGRATH & CO. PTY. LTD.
208 LT. LONSDALE STREET, MELBOURNE, VICTORIA, PHONE 32 3731



An underneath view of the amplifier, with most of the wiring components neatly arranged on tagboards. These are diagrammed on page 83. The vacant holes used for the tuner in the 106 tuner/amplifier are evident, but this area can very logically be used for a solid-state preamplifier board, if it is intended to use a high quality magnetic cartridge.

the constructor but the circuit itself ʼirtually unchanged.

As will be apparent from the photoıph of the chassis, two "push-in" type elded sockets are provided on the ır lip for connection to a stereo cartge. Where it is intended to use a ıgnetic cartridge, the connectors would wired to a transistorised preamplifier ard to boost and equalise the signal fore it is passed on to the valve ciritry proper. Where a ceramic or ʼstal pick-up is to be used, the preıplifier is unnecessary, the available nal being suitable for direct applican to the amplifier in the simple form pictured. (We plan to describe a table preamplifier in our next issue.)

As already mentioned two sockets are ounted on a vertical plate behind one tput transformer—a DIN socket for ;h level tape inputs and outputs and other socket (preferably dissimiliar) · possible connection to a Playmaster Λ radio tuner.

The various input signals are directed, desired, by the Selector and Mode itches to the grids of a 12AX7 highı twin-triode used as a preamp for th channels. Use of this high-gain lve secures an input sensitivity of 0mV RMS for full output, enabling en low output ceramic cartridges to ive the amplifier to full power.

In specifying a 12AX7 as a first oice, we are assuming that most conuctors of an amplifier such as this ll, in fact, select one of the better ality ceramics. If a crystal cartridge used, its higher output could lead to me distortion, since the 12AX7 approaches overload with input signals greater than about 1.7 volt RMS.

Those who already have a crystal cartridge on hand could reduce the gain by substituting a 12AU7 as a direct plug-in replacement. For best operating conditions, however, the cathode resistors should be increased to 2.2K and the 120pF capacitors in the input balance network reduced to 33pF. With the 12AU7, the sensitivity falls to 360mV for full output, a figure which is ample for crystal cartridges.

Alternatively, the signal output of any piezo cartridge—crystal or ceramic — can be reduced by connecting selected values of capacitor across the respective output leads. This has the added advantage of reducing the effective source reactance, relative to the load resistance and extends the bass response, whilst lowering the output over the rest of the range. A little experiment can establish the desirable conditons where the pickup can just comfortably overload the amplifier with the volume control a little less than full on.

The balance control consists of a single 2-meg linear potentiometer, with each "leg" connected to the triode grid in each channel and with the moving arm connected to earth.

Following the preamp. stage come the tone control networks and the volume control. Putting the controls in this relative position in the circuit makes it necessary to protect the preamplifier valve against overload, as already outlined, but it makes for a much "quieter" amplifier. Any hiss and hum from the preamplifier stage is attenuated by what-

'er amount the volume control is nor-ally retarded, while there is less gain llowing the controls to amplify cratching" sounds produced by faulty iriable elements.

As can be seen from the tone control sponse curves, generous bass and ›ble boost and cut facilities are pro-ded. This suits the amplifier to typical ›ookshelf" loudspeaker systems, which ually require moderate bass boost, hile still leaving enough bass boost r program correction or low level itening.

The tape outlets are supplied from the luF preamp. coupling capacitors via iK resistors. Notice that the shielded ble to the DIN socket is earthed at a ›int adjacent to the 12AX7 socket. The gnal to the tape outlets is independent ' the setting of volume or tone con-ols, allowing tape recording to proceed ith the amplifier completely silenced, · at any level desired for incidental itening or monitoring.

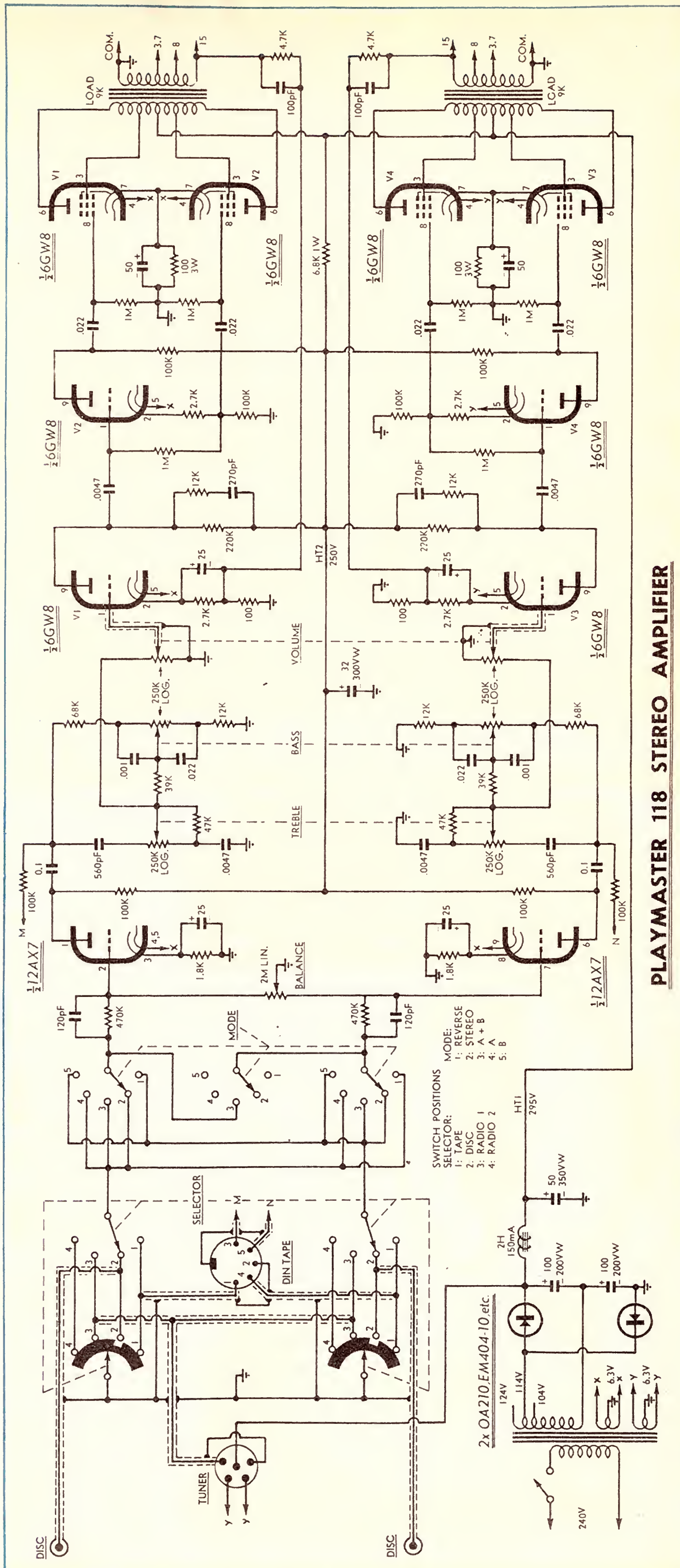
The rest of the circuit consists of two 3W8s in each channel, in a well-oven configuration that has been used ten in various projects over the years. ıe pentodes of the two 6GW8s are ›nnected in a push-pull "ultra-linear" ode.

The triodes of the 6GW8s are used voltage amplifier and phase splitter each channel. A step circuit is con-:cted in the plate circuit of the voltage nplifier to roll off the frequencies ›ove 20KHz and thus minimise the risk instability at supersonic frequencies.

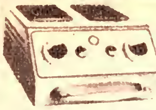
Negative feedback is applied from the i-ohm secondary of each output trans-rmers to the cathode of the relevant ›ltage amplifier triode. The feedback of the order of 14dB, which seems ıite "puny" when compared with the nount used in some transistor ampli-ers. However, the ultra-linear connec-on confers an additional benefit and ıe performance of the power amplifier a whole is very good, as will be 'ident from the distortion figures ıoted in the specification panel.

Notice the phase-correction capacitor ›nnected across the feed-back resistor. his is used to offset the phase rotation the output transformers as the fre-ıency increases. It is normally selected ;ing a square wave generator and a RO, but the value shown should be :ry close to the mark for the output ansformers which constructors are kely to use in this design.

The transformers are supplied with ıulti-tapped secondaries for loads of 7, 8.0 or 15 ohms. We suggest, how-'er, that the transformers be wired with



The complete circuit diagram of the new 118 amplifier, as it would be for those planning to use a ceramic pickup. For a crystal pickup, delivering higher output, it would be wise to substitute a 12AU7 for the 12AX7 input stage, or reduce the output of the crystal cartridge, as explained in the text. For a magnetic cartridge, a preamplifier will need to be added, which will be presented next month. In practical service, the performance of this amplifier should be indistinguishable from the 115 Playmaster, described in the May issue.

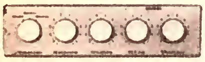


NEW IMPROVED 30 WATT

12v. All Transistor P.A. AMPLIFIER

No. 598—Complete Kit of parts to smallest screw. $57. No. 656 — Wired ready to operate, $60. Freight extra. Size: 6in w. x 3in h. x 8¼in d. Weight 6½lb.

MAGNETIC STEREO PRE-AMP



In 5Mv. out 500Mv. Bass and treble 18 D.B. No. 700C, $29. Wired ready for use, $31. Postage 30c.

COILS & IF's 455 Kc

Aer, R.F. osc. and IF's . .. $1.70 ea.
Ferrite Aer . . . . $2.
No. 265 Universal Tape OSC coil, $6.
Postage 10c. Write for details and price

STEREO

MULLARD 12 TRANSISTOR

5 watt x 5 watt.
Distortion ½ of 1%. Frequency response 30 cycles to 18Kc. Output 15 ohm speaker.
12in lg. x 7in d x 4in h.

Pre-Amplifier kit No. 616C	$26.00
2—5w Main Amplifiers No. 675C	$34.00
1—5w Power supply No. 681C	$16.00
Steel chassis, plated No. 649	$ 2.50
COMPLETE KITS, nuts, screws, etc. No. 471C	$78.50

Wired and tested, No. 471D, extra $5.00. Freight extra. Write for blueprint list of parts.

R.C.S. PRINTED CIRCUITS

For all R. & H., E.A., Mullard, Philips and other designs. Clearly coded. White letters and numbers, easy assembly and service, polished and resined for easy soldering. With blueprint parts list.
SPECIALS: To your drawing under 6in x 6in, $4.

New Printed Circuits		Recent Designs	
700 Magnetic pre-amp	$3	Part No.	
703 Mull. 7W. stereo.	$3	675 Hi-Fi 5W. amp.	$2.50
704 Pre-amp 67.P2	$2.50	684 Pre-amp. 65.P10.	$2.50
707 10W stereo. 67. P3	$2.50	685 Pre-amp. 65-P12A	$2.50
708 10W. amp. 67. A3	$2.50	686 Pre-amp 65.P12B	$2.50
709 Pre-amp 67.P5	$2.50	690 Philips 10W. amp	$2.50
		695 Electronic Flash.	$2.50

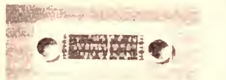
Write for full list. Immediate despatch. Postage 10c.

R.C.S. COMPLETE DO-IT-YOURSELF KITS

Peak reception, low price. No expensive test equipment. Everything fits. 1964 RF Transporta 7. Complete kit—No. 640 . . . . $43.50
Portable car radio, identical to 640 above, plus extra switch and car coil, etc. No. 642 . . . . $46.00
(Write for booklet on 640 and 642.)

Postage $1.

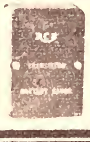
HI-FI BROADCAST TUNER UNIT 4 TRANSISTORS—HI SENSITIVITY



R.F., mixer, I.F., pwr. dectr. stages, adjustable aerial coupling. Kit of parts No. 659C, $24. Wired and aligned 659D, $25.50. Complete as illust., with 461 dial, knob and switch pot. No. 474, $31. Postage 40c.

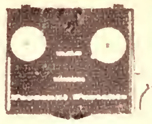
IMPROVED BATTERY SAVER KIT

4½, 6 or 9 volts. Replaces transistor battery power input 240 volts A.C. Maximum milliamps 100. Hum-free operation. Size 3½in l. x 2½in w. x 1½in h. No. 657, $6.50 (post 10c).



PERSONAL PORTABLES

Range 30 miles, 200 2 TRANSISTORS with short aerial and earth. Earpiece only, no speaker. Wired ready to use, No. 666D, $10.
Postage 20c.
Do-it-yourself kit, No. 666C, $9.00.



1 TRANSISTOR—1 DIODE

582 Do-it-yourself kit .. $5, post. 10c.
593 Wired ready to operate, $6, post 10c.

DIAL KITS

Scale gold with white letters. Size 6⅞in. x 2⅞in. to match.

- No.459 300pf gang, $4.00
- No.461 200pf gang, $4.00

Post 20c.

NEW AUDIO AMPLIFIER

4 transistors, ½ or 1 watt. Small size: cabinet 3" x 2" x 1" plastic. Suitable crystal P./up, intercom., microphone radio, etc. (9 volt)

Do-it-yourself kit 665, $10 (Post 10c).
Wired ready for use, 665D; $11.50.

NEW TRANSISTOR PREAMP KITS:

SIZE 3 x 2 x 1in 2 req. for Stereo.

LOW IMP. input 2 trans. 672C	$6.50
Wired ready for use, 672D	$8
HIGH IMP. silicon 2 tran. 680C	$6.50
Wired ready for use. 680D	$8
HIGH IMP. silicon 3 tran. 682C	$8
Wired ready for use. 682D	$9.50

Postage 10c each. Write for data.

R.C.S. *Order by Mail Order, Postal Note or Money Order (add post.), direct to—*
RADIO PTY. LTD., 651 FOREST ROAD, BEXLEY, N.S.W., 58-3491, 58-5385

choose your hi-fi equipment from the comprehensive range of PEAK turntables, record players, speakers, miniature speaker systems, headphones and amplifiers.

PEAK

STEREO EQUIPMENT

H. ROWE & CO. PTY. LTD. sole australian agents — adelaide brisbane hobart melbourne perth sydney

the brand you can trust for long life, high quality performance, attractive appearance to match any decor □ stocked and sold by leading resellers in all states

JRA/3/4/2/A

'Common" side of the secondary to sis and with the feedback taken, as 'n, from the 15-ohm tapping. The speakers can be connected across e or part of the winding, as requir-

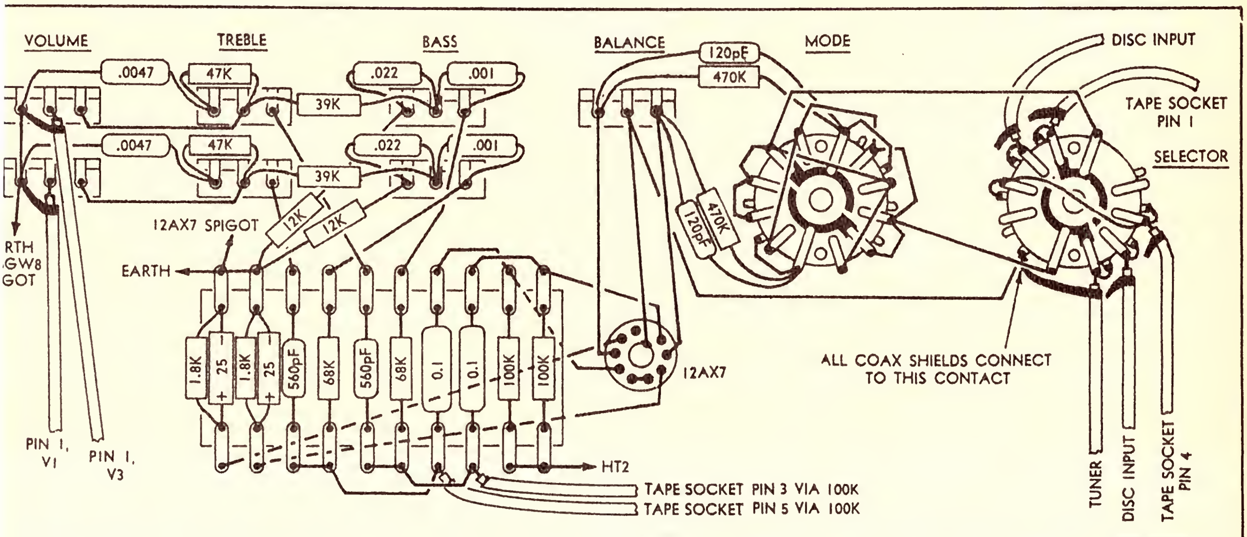
ie transformers sold for this and the er 106 Playmaster are constructed "grain-oriented" laminations. They rated for 12 watts RMS at 40Hz as such, are outstanding value for ey when compared to the "super-ity" types which extend the power onse to 20Hz and below — fre-

amplifier chassis which means that the chassis manufacturers can "pension off" the Unit No. 4 chassis. It allows a more compact layout for the valve circuitry, leaving the space normally occupied by a tuner to be utilised for a transistor preamplifier for magnetic cartridges. We intend to describe this in a future article.

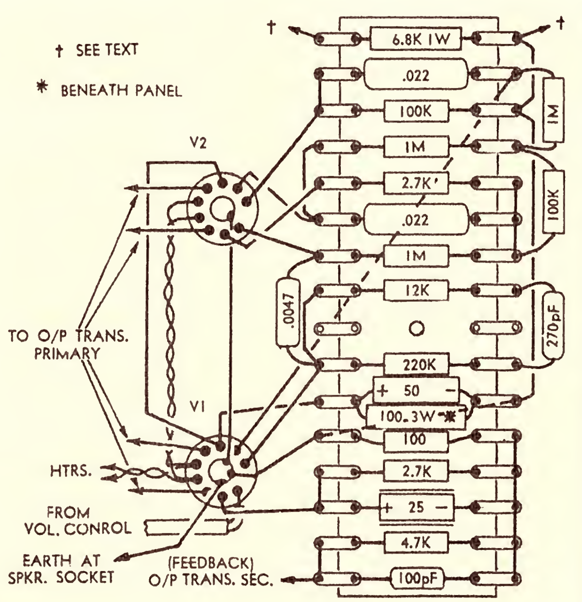
Combined with the chassis is the front panel from the Playmaster 115 transistor amplifier. This accommodates the new control layout, which is now standard on Playmaster stereo ampli-

hardware, such as the power and output transformers, should be mounted first. The power transformer should be mounted on the chassis with spacing nuts, leaving in position the nuts already on the transformer. If it is mounted flush on the chassis, the chassis tends to become part of the transformer core, aggravating any possible eddy-current and hum problems.

Note that the output transformers must be mounted as shown so that their cores are perpendicular to the plane of the power transformer core — this to



These diagrams should assist materially in wiring up the amplifier. Depicted above is the wiring for the preamplifier board and the adjacent tone controls. At the right is the wiring for one power amplifier board, the two being identical except for a pair of lugs used to terminate the HT wiring. It is suggested that the boards be checked for mounting position, then pre-wired before installation.



ncies which occur very seldom in re-ded music, anyhow!

Moving now to the power supply, it l be recognised as a conventional ltage-doubler" full-wave system, h an LC network for effective filter- of the HT supply. The regulation the power supply is sufficient to ble both channels to give the same ver before "clipping," whether they driven singly or simultaneously.

And now to the construction of the plifier: Here, the major differences ween the Unit No. 4 and the present plifier will become readily apparent. We used a Playmaster 106/107 tuner/

fiers. Some of our advertisers supply an anodised aluminium control panel to be used with the Playmaster 115, and this is attached to the front panel with the potentiometer nuts. However, it should not be mounted until the amplifier is complete and ready for installation, otherwise it may be marred by accidental scratches.

Four extra 1/8-inch clearance holes will need to be drilled in the front panel to enable panel and chassis to be screwed together. Use countersunk screws and see that the heads are flush with the surface of the sub-panel.

To begin the assembly, the bulky

ARTS LIST

1 Chassis 12¼in x 7½in x 1¼in (Playmaster 106/107).
1 Panel 12¼in x 4½in (Playmaster 115).
1 Printed label (Playmaster 115).
1 Power transformer, voltage doubler type, 114 volts AC, 150mA DC, 2 x 6.3 volts CT-3A.
1 Filter choke, 150mA, 2Henries, DC resistance 125 ohms.
2 Output transformers, A&R Type OT 4005, Ferguson OP412 or equivalent.
5 9-pin valve sockets.
1 2-pole 4-position rotary switch with "earthing plate."
1 3-pole 5-position rotary switch.
1 5-pin DIN socket, 1 5-pin socket for tuner.

VALVES AND DIODES

4 6GW8.
1 12AX7 or 12AU7.
2 Power diodes, OA210, EM404-10, etc.

CAPACITORS

2 100uF/200VW Electrolytics, "voltage doubler" type.
1 50uF/350VW Electrolytic.
1 32uF/300VW Electrolytic.
2 50uF/50VW Electrolytic.
2 50uF/6VW Electrolytic.
2 25uF/10VW Electrolytic.
4 .022uF/400VW plastic.
2 .01uF/400VW plastic.
2 .022uF L.V. (low voltage) plastic.
2 .0047uF L.V. plastic.
2 .0047uF/125VW plastic.
2 100pF L.V. plastic.
2 560pF L.V. plastic.
2 120pF L.V. plastic.
2 270pF L.V. plastic.
2 1000pF L.V. plastic.

RESISTORS
(half watt unless specified)

6 1M, 8 100K, 2 470K, 2 68K, 2 47K, 2 39K, 4 12K.
4 2.7K, 2 4.7K, 2 1.8K, 2 100 ohm, 2 6.8K 1-watt. 2 100 ohm 3-watt.

POTENTIOMETERS

3 250K(log) dual ganged, 1-2M(lin).

SUNDRIES

Miniature tagboard, 2 16-lug, 1 10-lug.
2 2-pin speaker plugs and sockets, 2 phono input sockets and plugs.
6 knobs as in illustration, dual lamp holder with lamp and bezel, rubber grommets, miniature tagstrips, shielded cable, hook-up wire, etc.

inimise the 50Hz hum induced in the /P transformers by leakage flux from e power transformer. The 1-inch long ›untersunk screws for mounting the gboards should be fitted before ounting the O/P transformers. All ›les in the chassis through which wires ıss should be fitted with grommets to op any chafing of the insulation.

Looking at the photograph of the nplifier layout above the chassis it will : noticed that we have moved one O/P ansformer forward by a distance of n. This is to accommodate the auxilry panel on which we mounted a DIN ›cket for tape outlets and inputs and so a socket for a tuner.

We made our panel from a piece of ›-gauge aluminium. The extra input ›ckets might conceivably have been ounted along the rear of the chassis ıt we preferred not to do so as they ould have been hard against the output ılve sockets.

Having mounted the transformers, the st of the "hardware" can be installed. ue to the different design of the voltge doubler capacitor brackets, we had › drill extra holes to mount them. We :-sited the filter choke for the same :ason. Extra holes have also to be rilled to fit another two screws to ount the tag-boards, which are longer ıan those in the original Playmaster)6.

Valve socket orientation will be :adily apparent from the appropriate hotograph. The potentiometers were :t back by the thickness of one nut, llowing only enough thread to proude to accommodate a nut and lock asher. This means that the control nobs can be mounted almost flush with ıe control panel.

Wiring can begin with the power ıpply and a word of advice to novice ›nstructors is appropriate here. Do not se the same coloured hook-up wire ıroughout the amplifier. It makes wirıg inspection and fault-finding so much more difficult. For example, red may be used for HT supplies, brown for heater supplies, black for earth returns, yellow for cathode networks.

The power supply is wired using the 114 volt tap on the transformer secondary. Those who intend using a Playmaster tuner are recommended to use the 104 volt tap otherwise the transformer will be overloaded, when the tuner is in use. Since the transformer is supplied with two 3-amp centre-tapped windings it is a good idea to load them equally. Each winding can supply a separate channel and preamp or tuner.

The tuner HT supply can be taken directly from the junction of the "voltage doubler" capacitor and filter choke via a 2Kohm decoupling resistor and a 32uF filter capacitor. This arrangement is least likely to upset the operating potentials in the amplifier. The network can be mounted in the amplifier chassis or tuner chassis; we chose to omit it to avoid crowding.

The power cord should be securely anchored using a metal clamp and insulated terminal block. The mains switch is incorporated with the volume control. This is an optional feature and some readers may prefer to keep all mains wiring away from the control section. Others like the convenience which the combined volume control/switch affords.

All wiring associated with the 6GW8 valves is contained in either of the two 16-lug tagboards. We have provided a wiring diagram of one of these tagboards which are similar except for the following: Notice the tags marked with an asterisk on the diagram; now refer to the under-chassis photograph and it will be seen that these tags are used to mount the HT filtering capacitors and the 6800-ohm dropping resistor.

In general, it is easier to partially wire the tagboards before mounting. For example, all the resistors and smaller capacitors can be inserted, soldered and

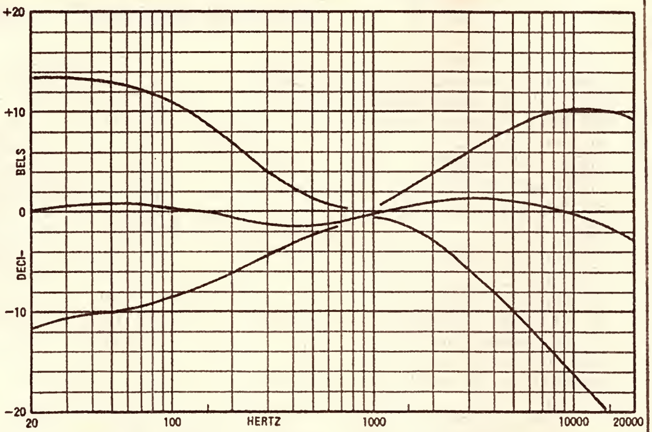
trimmed. Note that the cathode for the output pentodes is wired ı the tagboard. Make sure that it ammed hard up against the metal as the insulation might fail.

100Kohm resistors for the tape were mounted on a separate tagdjacent to the selector switches. resistors can be omitted if the do not require recording :s.

here a word about the colour to be used when connecting the transformers. Referring to the diagram of the amplifier tagboard

feedback should be correct. However, if the amplifier breaks into oscillation when it is switched on, the feedback can be reversed by simply swapping the leads to the grids of the two pentodes (pin 8, 6GW8).

All earth returns associated with the 6GW8s are made to points adjacent to speaker sockets. The earth returns associated with the preamp. valve are made to an adjacent point on the chassis, while the shielded cable for the input signal leads should return via the "shorting ring" on the selector switch back to the earthing point for the preamp.



response cur- for the 118 virtually the : as for the er 106 Play- er. Following ' is normal tice for high- ity systems, cross over at 1KHz.

:IFICATIONS:

POWER: 8.5 watts rms per channel into 16 ohms, prior to clipping.

DISTORTION: Total harmonic distortion at 2KHz at 1, 3 and 8 watts is 0.26, 0.37 and 0.42 per cent respectively.

CROSS-TALK at 1 KHz: (one channel driven to full power) —38 dB.

SIGNAL to NOISE RATIO: 53dB below full output.

INPUT SENSITIVITY: 110mV for all inputs with input impedance of 1.5M.

FREQUENCY LIMITS (—3dB): 18Hz and 20KHz taken at an output level of 1 watt. Bass control 13dB boost and 10dB cut at 50Hz; Treble, 10dB boost and 20dB cut at 15KHz.

OUTPUT IMPEDANCE: (from 16—ohm secondary) approximately 2 ohms.

DAMPING FACTOR: Appr. 8.

ave nominated the valve close to ear of the chassis as V1 and the valve as V2.

ıen using the A&R OT4005 transr, the colour code is:

SCREEN 1........Violet,
SCREEN 2.........Orange,
ANODE 1.........Blue,
ANODE 2.........Green.

e code for the alternative Ferguson 2 is:

SCREEN 1........Black,
SCREEN 2........Yellow,
ANODE 1.........Green,
ANODE 2.........Blue.

th the common terminal of seconwinding earthed, the polarity of the

The input shields should not be earthed at the input socket unless this proves later to give a noticeable reduction in residual hum and noise. The shielded cable to the grids of the voltage amplifier triodes is earthed to one of the 6GW8 spigots.

When assembly of the amplifier is complete all wiring should be double-checked against the circuit diagram. Then, if you have an ohmmeter on hand, check the HT line for short-circuits to earth. Touch the positive probe on the positive terminal of the first filter capacitor with the negative terminal connected to the chassis. The pointer should swing over towards zero and then move rapidly up the scale to a value of around 5Kohms, representing initial leakage through the filter capacitors.

The amplifier can now be switched on. Check the feedback as described previously. Then a check can be made on the "no-signal" voltages. If the voltages do not vary by more than about 10 per cent from those specified, the amplifier can be regarded as normal.

The following is a list of voltages obtained from the prototype using the 114 volt tap on the power transformer secondary, with no input signal applied:

HT1	295V
HT2	250V
12AX7 cathodes	1.3V
6GW8 pentode cathodes	7.8V
6GW8 triode (volt. amp.) cathodes	1.2V

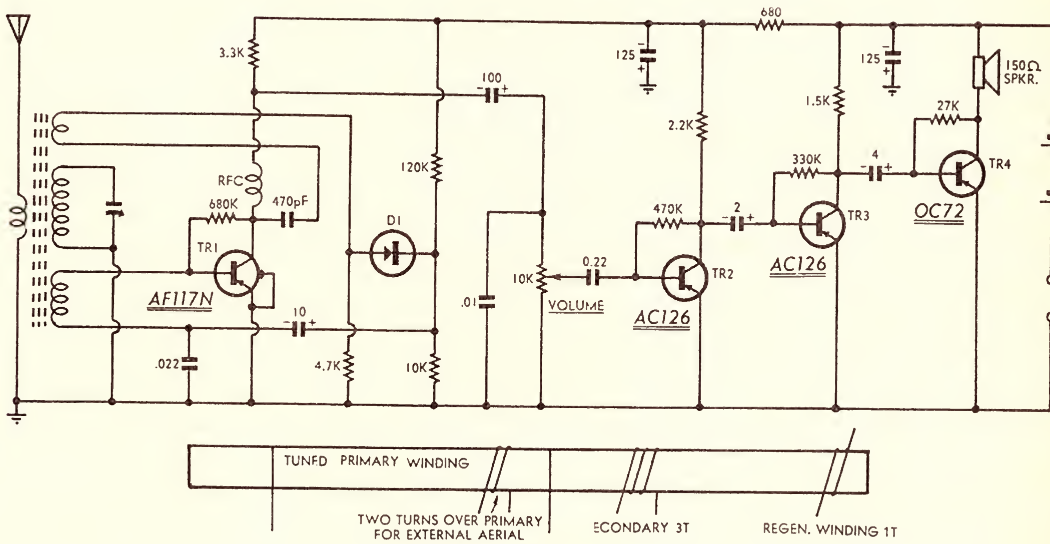
Incidentally, the signal to noise ratio on this amplifier was measured with a 470pF capacitor shunting the inputs to simulate a ceramic cartridge. This gave a signal to noise ratio of —53dB relative to full output which improves to about —56dB with "short-circuit" inputs.

Now, you can connect your turntable, put on a record and settle back to enjoy a few hours with your newly constructed stereo amplifier. It can certainly produce some very nice sound and—plenty of it, if need be!

A READER BUILT IT!

Circuits and devices which we have not actually tested in our laboratory but published for the general interest of beginners and experimenters.

EFLEX RECEIVER HAS FIXED REGENERATION



: would like to submit the following your 'Reader Built It' page. Other ers may gain as much satisfaction n it as I have.

The result of much experimenting, circuit consists of a reflexed stage lving the first transistor, coupled to igh-gain 3-transistor audio amplifier. ias enough gain to allow distant ons to be received at night, with the ferrite rod. With a short aerial an earth attached, stations can be ived with ease.

The regenerative turn greatly eases sensitivity and makes the selec- y quite sharp, at least for my loca- In my case the regenerative loop to be at least an inch away from primary to prevent the set from g into active oscillation. I chose to the pre-adjusted loop, but a con- ional regeneration system and con- could be used if preferred.

Again, I used a 6-volt battery to ly the receiver, but a 9-volt supply d be used, provided the current n from the battery by the output in particular was not excessive. used a ferrite rod 4 inches long of 3/8-inch diameter. The exact ber of turns for a given coverage depend on the tuning capacitor used, most experimenters will probably a standard winding and a tuning citor of about 400pF. The second- consists of 3 turns, wound at one of the main winding. When an out- aerial is to be used, it can be led to the receiver by winding two iree turns around the main winding, as shown in the diagram. Since the ferrite rod, used without external aerial, is highly directional in its pickup, it must be rotated for maximum pickup for the wanted station. In fact, this effect can be used for a volume control function, if desired, or to discriminate against an unwanted interfering station.

"Transistor TR1 is an AF117N, stabilised by means of a feedback resistor and operates at 0.4mA. The RF signal is amplified by TR1, then demodulated and fed back to undergo audio amplification. An AF117N is used in preference to other types, such as the OC44, because of its much higher RF gain. In the writer's experience, if an OC44 is used, sensitivity is greatly reduced. The 100uF coupling capacitor was used because it was the only one on hand when the set was built, but a much lower value could be substituted. Any residual RF signal is earthed by means of the .01uF bypass capacitor.

"The audio signal goes to TR2 and then TR3, both AC126s and operating at 0.8 and 1.25mA respectively. Both are stabilised by feedback resistors.

"TR4 was a 2SB223 transistor, but any output transistor such as an OC72 could be used. It operates at 15mA and drives a loudspeaker with a voice coil resistance of 150 ohms. Output power is sufficient to produce sound enough for most purposes. Total battery drain is about 18mA.

"The decoupling network to prevent 'motorboat' oscillations consists of 2 x 125uF capacitors and a 680-ohm resistor. Lower values of capacitor may be found adequate.

"Finally, the regeneration coil has to be watched. A slight amount of movement is enough to cause large changes in volume. If the coil is bumped along the rod, the set is likely to break into active oscillation which will not only cause annoyance to the family, but may also cause interference with neighbouring receivers in weak signal areas."

(From G. Embery, Box 56, The Summit. Southern Line, Qld.)

(Continued on page 158)

KNOW YOUR GRAMOPHONE*

A plain man's guide to records and reproducers

By JOHN BORWICK, B.Sc.

PART TEN—MORE ABOUT AMPLIFIERS

The subject of amplifiers was discussed in the last chapter (April 1967) with special reference to the various functions of the pre-amplifier/control unit. Now, without trying to produce an exhaustive study of amplifier theory, a few words will be devoted to the ways in which amplifiers work.

We can begin by saying how they don't work—in the way a simple transformer works. A transformer (see figure 1) is useful for stepping voltages up and down. It consists of two coils of wire wound on the same "former" in such a way that, when an alternating electric current is passed through the primary (input) winding, the resultant rising and falling magnetic fields link with every turn of the secondary (output) winding. When this happens, the magnetic field induces a current into the secondary winding corresponding to a voltage which can be greater than the applied voltage in direct proportion to how many times the number of turns of wire in the secondary exceeds that in the primary. Thus, if the turns ratio is 1 : 2, the voltage is doubled; 1 : 3, the voltage is trebled and so on.

But "you don't get anything for nothing in this world," to paraphrase the Law of Conservation of Matter. Therefore the actual power in a transformer secondary cannot exceed that in the primary. (Indeed it will be slightly less, as the transfer is always less than 100% efficient.) And, since electrical power = voltage x current, a transformer which gives a 2 : 1 step up in voltage will halve the current which can be drawn.

By an extension of this argument, it can be shown that impedances can be stepped up or down via a transformer, the ratio of the impedances being the square of the turns ratio.

How an amplifier amplifies: An amplifier genuinely boosts the power of the electrical signal and it does so by drawing on the steady power available from the AC mains supply (or batteries).

In the simple triode valve circuit in figure 2, once the heater has warmed up the cathode, the latter will emit a stream of electrons (negatively charged particles). These will drift through the evacuated valve interior towards the positive anode and so create a steady flow of current through the anode load resistor R.

Now, when the alternating input signal is applied to the grid (which is an open mesh construction placed between the cathode and the anode) the swings in grid voltage will cause an increase

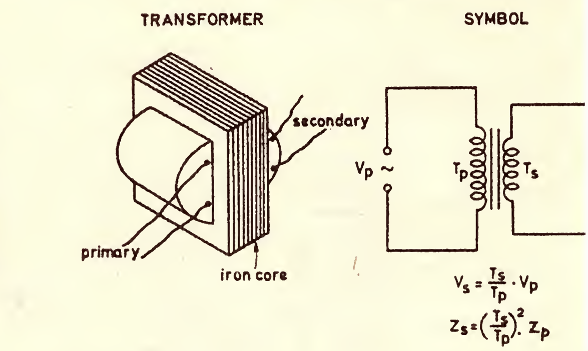


Figure 1: A transformer will give a step up or down in voltage according to the turns ratio. It may also be used for impedance matching

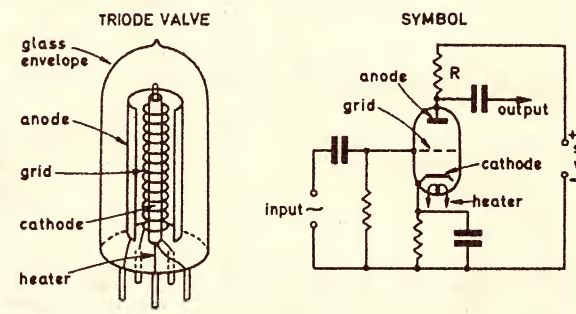


Figure 2: A triode valve will amplify AC signals by drawing power from a supply voltage.

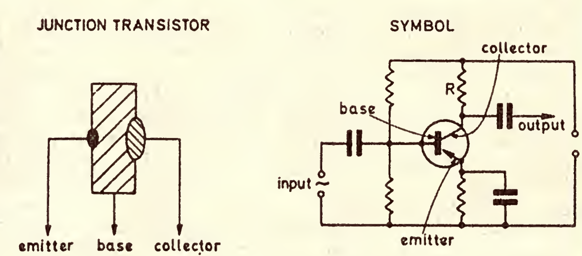


Figure 3: A transistor similarly depends on a power supply. The particular configuration shown here is called "common emitter".

or decrease in the flow of anode current. Furthermore, because the grid is closer to the cathode, it is found that a comparatively small input signal voltage can cause large changes in anode current and, since this current flows through R, the swings in voltage drop through R represent an amplification of the original signal.

The transistor amplifier: The transistor amplifier works on an entirely different principle. It is essentially a sandwich of semiconductor materials — figure 3 shows one of the possible configurations, with its circuit symbol. The basic material of a transistor, germanium or silicon, has no "free" electrons and so it is a non-conductor. During manufacture, however, small amounts of impurity can be added to upset the electron balance and so produce a "semiconductor" material. Depending on the choice of impurity, the semiconductor can have too many electrons (N or too few (P-type).

If a DC voltage is applied to a of N-type material, the surplus ele will drift towards the positive ter Similarly, in a P-type material, th or "holes" where electrons are n can be taken to drift towards the tive terminal. When a P-N junc formed, a degree of diffusion takes so that an electrically neutralised exists. Then, to produce a given c flow, it will require the applicatio DC voltage or bias.

A transistor can be made to amp the correct choice of bias applied two junctions. In figure 3, for ex if the bias were arranged so as t the base-collector circuit a much resistance than the emitter-base then, although the currents in eac cuit might be very similar, a co able power gain is possible. (Powe circuit is given by the square current times the resistance, so a r equal current in a larger resistanc responds to the desired amplific The name transistor was actuall veloped from the two words "tr resistor."

Figure 3 has been drawn in im of figure 2, to emphasise the poi similarity between a simple valv transistor amplifying stage. It will b that the input is applied to the b the PNP transistor (c.f. the grid valve) and the output is taken fro collector (c.f. the anode of the The emitter in this "common er configuration is equivalent to the

* ***Reproduced by arrangement with "Gramophone" magazine.***

e of the valve and is nmon to both the input and :put circuits. The potential divider in base circuit gives a stabilised nega- bias to the base. The by-passed istor in the emitter circuit appears resemble the cathode bias resistor the valve diagram but is actually to npensate for temperature variations.

Points of difference between the valve l transistors circuits are readily n. For example, the transistor circuit of opposite polarity (true only of P transistors). Also, the supply vol- e is only a few volts, compared with und 200 volts for valves. This, com- ed with the greater efficiency of tran- ors, means that a much simpler pow- unit will suffice, less heat is generated l there is less risk of mains hum. relatively lower impedances of nsistor circuits have made it possible a variety of designs to be produced which direct coupling to the loud- aker takes place. This means that output transformer can be dispensed h — perhaps the most expensive nponent in a valve amplifier.

Precautions are necessary, when work- with transistors, to avoid either ex- sive heat or short circuits. The form- risk has led to the fitting of vaned t sinks for mounting power transis- s — so that a large area is available heat radiation. The latter is combat- by the insertion of fuses in the HT and the design of more elaborate dspeaker terminals — to reduce the of accidental short circuits.

ooking at specifications: To round this section on amplifiers, here are ne comments on the technical proper- listed in makers' specifications. By of example, we shall use extracts n the specification of the Rogers let Mark III stereo amplifier.

A TYPICAL SPECIFICATION

Inputs	Sensitivity	Impedance
Pickup (magnetic)	3.8mV	68K
Pickup ceramic/crystal)	65mV	2M
Radio	100mV	470K
Tape	600mV	—

Frequency response: 20-20,000Hz ± 2dB.

Harmonic distortion: 0.8% at 10W 0.25% at 5W (at 1,000Hz).

Intermodulation distortion: 3% at 10W (using 5Hz and 6,000Hz 4 : 1).

Signal-to-noise ratio: 60dB (radio); 54dB (Magnetic pickup).

Crosstalk: −42dB at 1,000Hz; −26- dB at 10,000Hz.

Power output: 10 + 10W (sine wave); 12.5 + 12.5W, (IHFM music power).

Power response: 9W, 40-10,000Hz.

Output impedance: 3-5 ohms and 12- 16 ohms.

COMMENTARY

nput sensitivity. The voltages given ere are those required to give the ated power output (see 8).

'requency response. The range from 0 to 20,000Hz covers all audible ounds. The qualifying ±2dB indiates the maximum amounts by 'hich the amplifier response may ary within this range, 1dB (decibel) eing about the smallest change in :vel detectable by the human ear. pecifications which quote a frequency range" without this type f level qualification are meaningless.

Harmonic distortion. All amplifiers ;nd to introduce this type of distoron, which consists of the spurious roduction of harmonics (simple mul-

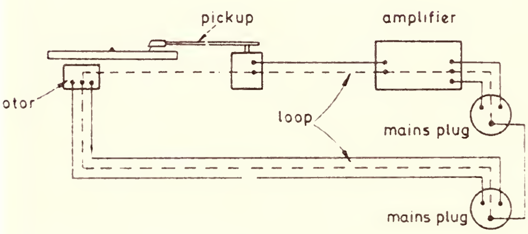
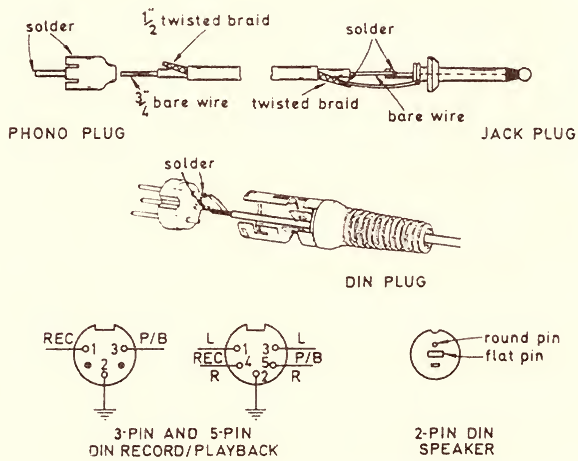


Figure 4: The earth loop, (broken line) gives rise to mains hum. It is avoided by omitting the earth connection on the motor mains plug or the motor/pickup earth lead



're 5: Showing right way to 1ect up some ular types of al plug. The 7 connectors drawn as seen 1 the free end 1e plug, or the of the socket.

ples) of each frequency present in 1e input signal. The amount of the istortion (given as the total level of armonics as a percentage of the gnal level at, say, 1,000Hz) in:ease at higher levels, as shown mounts less than 1% may be rearded as acceptable.

ntermodulation distortion. For the ame reason (non-linearities in the ansfer characteristic) all amplifiers :nd to introduce intermodulation disortion. The result is the spurious roduction of sum and difference freuencies corresponding to each pair f frequencies present in the input gnal. The amount of the distortion ; given as the total level of unwantd frequencies as a percentage of the :vel of two test frequencies fed in at 1e stated ratio (and in valve ampliers is usually about four times the armonic distortion). Amounts less han 3% may be regarded as cceptable.

ignal-to-noise ratio. This is quoted s the number of decibels by which 1e rated signal level exceeds the inerent noise level. This figure should nclude mains hum, unless otherwise stated, and may be a "weighted" figure —which means that the noise signal during measurement is passed through filters simulating the falling response of the ear at high and low frequences. Ratings greater than 50dB may be regarded as acceptable.

6. Crosstalk. Some break through of the left channel signal to the right channel and vice versa is inevitable. The negative dB rating expresses the ratio of this unwanted signal to that in the "wanted" channel. A figure of —40dB at mid-frequencies may be regarded as acceptable.

7. Power output. This expresses the electrical "size" of the amplifier — as the number of watts of electrical power it can deliver to the stated output impedance (see 9) without appreciable distortion. It is perhaps unfortunate that several alternative methods of specifying power have been introduced — two of which are used here. The "sine wave" method is generally to be preferred and simply states the RMS (root mean square) power attainable on steady tones. (Peak power would be twice this: peak power ratings are often quoted in America). The IHFM (Institute of High Fidelity Manufacturers—USA) definition of "Music Power" assumes that the DC supply voltage remains at the no-signal value. It tends to flatter amplifiers with badly regulated power supplies. In a good amplifier the IHFM rating should not exceed the RMS figure by more than about 30%

8. Power response. This important criterion specifies the bandwidth between the limits where the power output falls to half (—3 dB) for the rated distortion.

9. Output impedance. The figures given here are nominal and correspond to to the loudspeaker impedance required for optimum power transfer. Standard

impedances are 3.5, 7 and 15 o
in the U.K., 4, 8 and 16 ohms in
U.S.A. In general, the impeda
need not be critically matched,
the loss of efficiency resulting f
the use of a 15-ohm loudspeaker
commonest impedance in Britain)
a 3-ohm transistor amplifier (a c
mon value on the Continent) is f
serious and should be avoided.
question will be discussed in the
instalment.

Connecting up: My earlier mentior
loudspeaker terminals leads me to
important subject of connecting pi
of equipment together. After all, the
cuit details interest only a few gra
phone users, whereas we are all li
to be faced with the need to con
a pickup to an amplifier, to a l
speaker, to a tape recorder, etc. Stran
the fitting of plugs and the choice
care of connecting cables are
fiddling operations that some people
into all sorts of trouble with them.
avoid this trouble:

1. Use the right types of conne
2. Use great care in wiring.
3. Call in expert advice if you
really stuck.

Let us first talk about the mains
nections. Ideally, one — and only
— of the pieces of equipment in
gramophone installation should be v
via a three-core cable and three-pin
to a three-pin mains socket. The t
longer, pin is the earth connection. H
is the correct way to connect a th
pin plug. Strip back the outer cove
from the flex end for a distance of 2i
necessary, bind the frayed ends of t
with insulating tape. Position the fle
that the still-covered portion is as
inside the plug as it can go; now
each wire to allow it to run to the
rect terminal, plus ½in for win
round the terminal. Strip the cove
from the wires and wind the bare v
clockwise to tighten. Connect the
wire and the black wire to the "ma
pins and the green wire to the "ea
pin. Twist and wind the wire on to
terminals in a clockwise direction so
when the nut is tightened the wir
tightened with it. Make sure there
no stray strands of wire, fit the plug
and screw up.

The reason why I have suggested
only one unit should have an earth
nection is to avoid what is called
"earth loop." Stray currents and m
netic fields, from transformers, etc.,
an ever-present source of 50Hz m
hum. These fields will induce bothers
signals if a completed loop is allo
to exist via earth.

In figure 4, for example, the e
loop is shown as a dotted line. It
be broken either by leaving the e
wire off the turntable mains plug o
omitting the earth connection betv
the motor and the pickup. When a t
or a tape recorder is coupled to an a
lifier, the braiding of the co-axial si
leads should normally be the only e
route provided.

Signal connectors: It is a pity that e
tive standardisation has not been
ieved for the types of plug and so
used in domestic gramophone equipn
However, the sketches in figure 5
demonstrate the correct proce
for wiring the three most common ty
namely phono, jack and DIN plugs.

The phono and jack plugs are simple ough since they consist of only one ve" lead and one "earthy" lead (usually braiding on a co-axial cable). The N (Deutscher Industrie Normenaus- uss) plugs appear in various formats. e standard style of three-pin, five- and two-pin DIN plug are shown in ure 5, but equipment manufacturers ll sometimes alter the functions of the rious pins, so it is as well to check eir instruction leaflets before doing any ring.

The drawings of the DIN connections of the plug viewed from the free d, or the socket from the solder tags d. It will be seen that the central pin is invariably earthed. Pin 1 is the cord connection in both three-pin and e-pin systems (the latter type being ed for stereo) and Pin 3 is for play- ck. The two-pin system is widely used loudspeaker connections and may be ed in a reversible version so that ad- g an extension loudspeaker may or y not mute the built-in loudspeaker. l other DIN plugs possess a key-way d are irreversible.

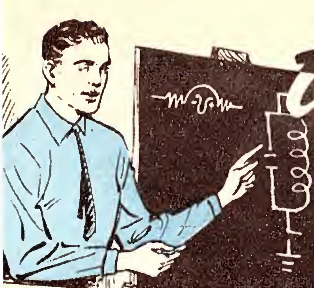
The next instalment will deal with dspeakers, the types available, amp- er matching and positioning for stereo tening.

Wildlife Recordings

The sounds made by animals are a gular feature of B.B.C. radio and tele- sion programs about wildlife and en figure in programs. They are drawn m the B.B.C.'s collection of natural story recordings, one of the largest col- tions of animal sounds in the world, the headquarters of its Natural His- y Unit at Bristol. The person respon- le for building up this collection—and nself recording many examples in the ld—is its present librarian, the well- own naturalist John Burton. In a B.C. broadcast recently he talked about work to producer John Sparks.

"There are 412 discs in the library, presenting 748 species of animals and 0 birds," he said. "It all began with dwig Koch, the famous naturalist and oadcaster. Koch retired in 1951 and s succeeded by Eric Simms, who made ll use of the first portable tape recorder d the parabolic reflector and added any new recordings to the collection."

Burton said that in the last decade or , with the development of good reliable pe recorders, the number of recordists wildlife, amateur and professional, d snowballed. He bought quite a lot their recordings to make as represen- tive a collection of world wildlife as ssible. "It's very expensive for the B.C. to send me to faraway places like frica, Australia or South America to ake recordings, but I have contacts e, for example, Anthony Walker in hodesia who recently sent me a tape of Eastern Scrub Robin. Some of our cordists in Britain have sent me splen- d recordings. Sometimes an amateur thusiast sends me a recording of, say, very rare bird which may not be tech- cally perfect, but is of considerable his- rical, tropical and primitive interest, r instance, a recording of a Great Reed arbler." Recordings, he said, must be ee of extraneous noises and should be corded at a speed of not less than ips.



the "Answer Man" Explains

ABOUT DELAYED SOUND IN MOVIES, SATELLITE RELAYS

A reader's question about loss of sound synchronisation in a television movie provides opportunity to have a closer look at the subject of sound sync. both in relation to films and to the very new subject of transmitting television via synchronous satellites.

During a recent TV film presentation was surprised to observe a serious loss f sound synchronisation. The sound iiled for a second or so and when it sumed it was lagging the action by bout this amount. This situation preiled for several minutes, and was quite sconcerting. Then the picture blacked it for about a second and synchronisaon was restored. How could this happen the sound and picture are on the same iece of film?

Fortunately our correspondent supied exact details as to the channel, e name of the film, and screening ate, so we took the opportunity to ieck with the station concerned. They ere most co-operative, and provided the illowing explanation:

TV stations use 16mm versions of andard 35mm theatre release prints. hese combine the sound and picture nages on the same piece of film, as in e original 33mm print, or as in 16mm ints for conventional projection.

In any sound film system it is necesry to scan the sound and picture images different points in the transport sysm. This is because presentation of the cture image requires intermittent movement of the film, a frame at a time, ist the projection gate. For obvious asons the sound can not be picked f at a point where the film is moving this manner. To overcome this probm, the sound is picked off at a point ter in the transport system — usually low the picture projector — and after e intermittent action has been removed by an isolating loop and sprocket. The sound head provides further smoothing of the film movement by means of rotary stabilisers, and additional loops, so that it achieves virtually constant speed by the time it is scanned by the optical sound system.

To offset the difference between the sound and picture scanning points, the sound track is printed ahead of the picture by exactly the length of film required between the projection aperture and sound head. In the case of 35mm films this is 19 frames. For 16mm it is 24 frames. Set-up marks for both the projection aperture and the sound head are provided on the film leader and, provided these are correctly located when the projector is threaded, sound and movement must synchronise and remain synchronised.

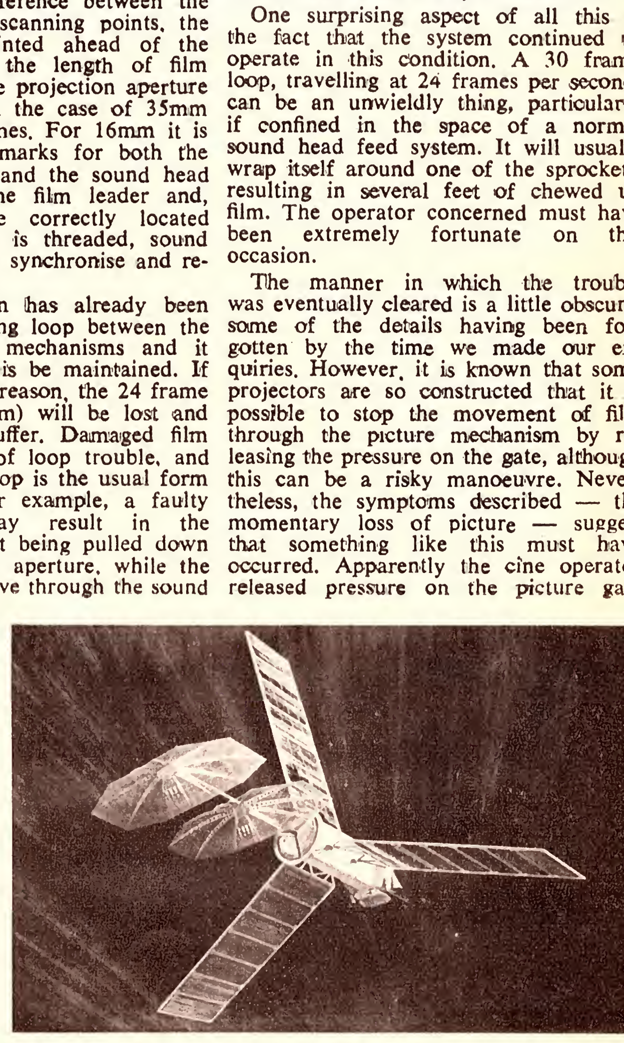
However, mention has already been made of the isolating loop between the picture and sound mechanisms and it is important that this be maintained. If it is altered for any reason, the 24 frame difference (for 16mm) will be lost and synchronism will suffer. Damaged film is the usual cause of loop trouble, and loss of the sound loop is the usual form which it takes. For example, a faulty sprocket hole may result in the associated frame not being pulled down from the projection aperture, while the film continues to move through the sound head. The effect of a lost loop on the film transport is so chaotic that, regardless of synchronising problems, it is usually essential to stop the machine and rethread it.

In the case we are considering, something like the opposite effect occurred. Apparently due to a faulty splice, the film jammed in the sound head for a period equal to 30 frames — about 1.25 seconds — during which time a 30-frame oversize loop was created between the picture and sound mechanisms. It was this stoppage which caused the brief loss of sound and the oversize loop which ruined the synchronisation.

One surprising aspect of all this is the fact that the system continued to operate in this condition. A 30 frame loop, travelling at 24 frames per second, can be an unwieldly thing, particularly if confined in the space of a normal sound head feed system. It will usually wrap itself around one of the sprockets, resulting in several feet of chewed up film. The operator concerned must have been extremely fortunate on this occasion.

The manner in which the trouble was eventually cleared is a little obscure, some of the details having been forgotten by the time we made our enquiries. However, it is known that some projectors are so constructed that it is possible to stop the movement of film through the picture mechanism by releasing the pressure on the gate, although this can be a risky manoeuvre. Nevertheless, the symptoms described — the momentary loss of picture — suggest that something like this must have occurred. Apparently the cine operator released pressure on the picture gate

Artist's concept of a satellite configuration which Lockheed Missiles and Space Co. is to study for the U.S. Communications Satellite Corp. The aim is to develop a satellite which will cope with domestic television and telephony distribution throughout the U.S., as well as intercontinental television and phone traffic and VHF or UHF traffic to ships and aircraft. Two 6 x 9ft umbrella-like dishes are for transmission, while a smaller dish at the far end is for reception. Also at the far end is a pair of supplementary horns, one for receiving, one for transmission. The "wings" carry solar cells which power the vehicle.



st long enough for the sound sprocket take up the excess film, momentarily acking out the picture while he did so.

And while we are on the subject of und and vision synchronisation, it may interesting to note some figures which :re quoted recently on this subject. iese were the results of some experi- :nts conducted in the U.S.A. and inada to determine how much error n occur without producing noticeable pairment in the presentation. Strangely ough, these investigations were not ompted by motion picture interests, t rather by those handling synchron- s satellite transmission of TV signals. some cases of satellite transmission it more convenient to send the accom- nying sound by an alternative route, :h as an international telephone cable. this case the sound will arrive at its stination ahead of the picture, due to : quite long round trip path via the tellite.

A synchronous satellite orbits some ,000 miles above the earth. By the ne we consider the angle between the coming and outgoing signals the total th is unlikely to be less than 50,000 iles. At a speed of 186,000 miles per cond, this amounts to .37 second 70mS) and, even if we subtract from is the time the sound takes to complete journey, the difference will still be bstantial and probably close to 300mS. iis has been overcome in the past by cording the sound on a tape loop, th the replay head located the required imber of milliseconds away from the cord head. It was probably a desire know just how much tolerance was rmissible in such an overall system iich prompted the test.

The results of these are particularly :eresting, in that they show a different der of impairment depending on whe- er the sound leads or lags the vision. :cording to the report, ". . . a just ticeable impairment is produced, for p.c. of observers, when the sound delayed 140mS relative to the vision, when the vision is delayed 70mS lative to the sound." From this, the riousness of a 300mS vision delay will immediately obvious.

Reverting to our motion picture situa- in, what do these figures mean in :ms of the number of frames by which loop can be in error before it is iticeable. At 24 frames per second, ch frame represents about 41mS, so at a loop error of two frames in such direction as to delay the vision—i.e., loop that is two frames too small— uld produce a more than noticeable ror.

In some 16mm systems at least, this der of error is quite feasible without oducing any obvious malfunction of e film transport. Only by taking proper ite of the set-up marks on the leader prescribed contours for the loop can rrect operation be ensured.

In the reverse direction the tolerable ror is greater but, equally, the scope r error is greater. For example it would quire an oversize loop of four frames exceed the permissible sound delay, it there would be no great difficulty in icommodating such a loop on some achines. So, once again, careful thread- g is the only answer.

And, finally, we understand that some rge theatres deliberately modify the iund/vision relationship to allow for e time needed for the sound to reach the back of the hall. With sound travelling at about 1100ft/s (approx.) it will suffer a delay of 100mS for every 110ft it has to travel to the listener. At a distance of about 150ft the delay will be close to 140mS tolerance and, at greater distances, could be objectionable. It would seem logical, therefore, to advance the sound as much as possible to offset this, provided it did not exceed, for the front row patrons, the 70mS maximum permissible sound lead.

★ ★ ★

Imported dynamic microphones seem to be sold with about nine feet of shielded wire attached. Is there any objection to extending this lead by twenty or thirty feet, provided shielded wire is used?

We take it that you are referring to the type of microphone which is currently being sold for about twelve to fifteen dollars apiece, and used for non-professional public address and tape recording.

Most such units are of the so-called "high impedance" variety, meaning that they incorporate an output transformer and are meant to feed into a preamplifier grid or base circuit having an input impedance of upwards of 10,000 ohms. The output lead is usually a single, shielded conductor, with an outer plastic sleeve.

An additional length of shielded wire would increase the total capacitance shunted across the output transformer secondary and reduce treble response. The order of such treble loss would depend on the actual impedance of the microphone and input circuit, and on the amount of added capacitance. Naturally, the exact nature of the extension cable is most important in terms of shunt capacitance.

As a matter of interest, we connected to our R/C bridge a measured length of plastic-coated shielded hook-up, characterised by a stranded inner conductor and a relatively thin layer of black insulation between it and the earthed braiding. Such cable is commonly used for short runs within an amplifier. This wire turned out to have a capacitance of about 150pF per foot and a mere 6 or 7 feet, representing about 1,000pF, proved sufficient to drop the output of a typical high impedance dynamic microphone by something over 3dB at 5KHz. Therefore, unless quite severe treble loss could be tolerated, a long length of such cable would be out of the question.

On the other hand, so-called "microphone" cable, having much the same inner conductor, but surrounded by a slightly thicker layer of clear insulation, exhibited a capacitance of about 47pF per foot, indicating that about 20 feet of such cable could be used as an extension for a similar treble loss of 3dB at 5KHz. Some cable would appear to have lower capacitance again than this but it is more bulky and more expensive — perhaps, unacceptable so.

While a modest extension is therefore practicable, assuming the use of suitable cable, the best course, really, is to buy a low-impedance version of the microphone, with separate output transformer — assuming this to be available. The cable can then be extended over any likely distance, using either single-wire or double-wire shielded cable, according to what is already attached to the microphone.

The mic/grid transformer can then be fitted into the cable a short distance from the amplifier. It should only be installed in the amplifier chassis if it is a type thoroughly shielded against fields from the power transformer; it also means that everything fed to the input channel must then pass through this transformer, which may or may not be convenient.

Finally, here's a tip for those who are not too heavy-handed and who are prepared to attempt a modification **at their own risk:** The high-impedance dynamics can usually be disassembled to reveal the output transformer in the body of the case. It can be taken out and the speech coil wiring run straight to the existing output cable. Keeping careful note of the original connections, the output transformer can then be housed in a protective shield and wired into the cable adjacent to the amplifier. A stout protective and antimagnetic shield can be contrived from a water-pipe junction or a short length of ferrous pipe, with the ends plugged to retain the leads and the whole thing wrapped in tape.

Another tip: Don't measure continuity through microphone transformers with an ohmmeter. DC can adversely affect the core material.

AUDIO TOPICS

:OMPATIBLE PICKUPS—NOT RECORDS!

The attitude of the major English companies to compatibility is summed up by the phrase; "Not compatible—Stereo only."

By Neville Williams

Last month in these pages, under the ading "How Compatible Is Compat- le?" we explained the background to e so-called compatible stereo/mono scs now being sold in Australia and sewhere. We pointed to the factors nich rendered it self-contradictory to nsider at one time a technique which ould: (1) Preserve the full stereo poten- il of the 45/45 recording system and) Produce a record without signifi- nt vertical modulation and therefore one to damage by at least a propor- m of existing mono pickups. Really it iled down to producing stereo records, lieved of extremes of vertical modula- n, with the hope that the repercussions playing them with mono pickups ould be minimal. Mention was made at the major English companies were t in sympathy with the idea.

Hardly was the article in metal, when ws came to hand of a press release the EMI Company in England. We iote:

"One of the most important-ever developments in the record industry is revealed in the announcement today by EMI Records that from next July their classical long-playing records will be released in stereo only. A decision regarding stereo-only 'pop' LPs will be taken later in the year.

"The move does not make obsolete the mono record player. In fact, by using any modern lightweight record player pickup the stereo-only LP can be played on the mono record player. But EMI point out that for best results they recommend the use of a stereo pickup cartridge — now marketed at a reasonable price — to convert the mono record player. True stereophonic reproduction will, of course, be obtained only from a complete stereo reproducer."

Commenting on the proposed move, a okesman for EMI went on to explain:

"We decided to take the initiative in introducing stereo-only classical records because we are quite sure it is an inevitable development largely made possible by the tremendous progress in record reproduction techniques and equipment.

"This stereo-only decision will benefit both the record dealer and the record buyer. The dealer will not have to order both mono and stereo LPs, and so duplicate his stock, and consequently he will be able to offer his customers a much wider range of recordings for selection."

Superficially, the announcement by EMI simply brings it into line with other major European companies who have already swung over to stereo only. ("Australian Financial Review" 26/5/67 quotes Telefunken, Polydor, Philips and D.G.G. as having produced only stereo or stereo/compatible versions for the last 12 months.) The vital difference is that EMI is not lending its support to the idea of branding its records as "compatible," in the sense that they can be played without damage by mono pickups. On the contrary, EMI would like to see record users re-equip with stereo cartridges, whether or not they proceed to a full stereo replay system.

Writing in "The Gramophone," John Borwick is apparently in full accord with the attitude of EMI. He says:

"In practice, these compatible records were a source of disappointment to a number of record-buyers who found that distortion or groove jumping took place with certain types of mono record players. Indeed, I have just heard that one budget-price record manufacturer in this country who recently brought out 'compatible' records has gone back to producing separate stereo and mono versions.

"So the 'compatible' record, which is essentially a stereo disc in which the maker attempts to avoid tracking problems on older mono pickups by subtly reducing the vertical element in the complex recorded waveform, has not been a success. It would seem that EMI, Decca and other large manufacturers were right in having nothing to do with this type of technical compromise. In record reviews in 'The Gramophone' we have simply treated these records as stereo and judged them accordingly."

In further discussion, John Borwick points out that discs recorded to the 45/45 stereo system are—and always have been—truly compatible in that they contain information in a form where it can be extracted and played in either stereo or mono. Likewise, a stereo cartridge is truly compatible in that it will track a 45/45 disc and will deliver either a stereo or mono signal according to the way in which its outputs are utilised. A conventional mono cartridge is NOT necessarily compatible, because it may lack the ability to track the vertical modulation component. This being so, non-vertical-compliant cart-

World Record Club

In their May, 1967, brochure, The World Record Club refer to the EMI announcement and point out that, already, 12½ per cent of their releases are in stereo (or stereo-compatible) only. The proportion is likely to rise steeply and, by mid-1968, virtually all new classical releases will be in stereo only. In answer to the question "What can you do about it?" the club advises:

"You can replace your mono equipment with stereo. But this could be very expensive — and possibly unnecessary. The next best thing to do is to replace, if possible, your mono playing head with a stereo cartridge and stylus. In most cases this will give you trouble-free reproduction, though of course without stereo effect. Lastly, if your playing-head is sufficiently light and the stylus assembly of sufficiently high compliance, you can play stereo and stereo-compatible on your existing mono equipment. You will get an acceptable mono sound — but you will permanently inhibit the stereo character of the playing grooves, and produce in effect what is a mono record—which will never again be truly effective as stereo. This in any case must be regarded as a last resort. Playing stereo records with a mono cartridge and stylus—even under optimum conditions—is asking for trouble, even though technically possible.

"The course mono members choose to follow is a personal decision and will obviously be influenced by a number of factors. But certain it is that mono is going out—and going out fast."

ridges should be sacrificed, not standard of ultimate performance. He goes on t stress that the industry should lend i weight to seeing that mono players ar equipped — or re-equipped — wi cartridges which will play full, stere recordings. We quote:

"This can be achieved in two way First, a stereo cartridge could b fitted, with the two live leads and th two screens respectively joined t gether to form the mono outlet. Th solution is perfectly acceptable, but does mean a slight waste since th two sensing elements, etc., must ha cost more to make than a mor transducer. (Also, no stereo equiv lent to the existing mono cartrid may have been marketed.)

"The second approach is to fit mono cartridge with the right chara teristics, namely:

1. Fine stylus with tip radius 0.0007in or less.
2. Low playing weight.
3. Reasonably high vertical cor pliance and low mechanical r sistance.
4. Similar impedance and outp voltage rating to the mono ca ridge previously fitted.

"This latter approach has now r ceived official backing and I ha been told that, at a meeting on Ap 5, representatives of the equipme component and record manufacture reached agreement on a working pr cedure. In future, mono pickups w be marked on the box or on t cartridge to show whether they a suitable for playing stereo record They will have styli in the ran 0.0006/7in and the test will be th ability to track a special 7-inch t record produced by EMI Recor This has gliding tones at +22dB wi reference to 1cM/s and has alrea been supplied to interested manufa turers.

"If this recommendation is compli with, we may expect all future Briti mono record players and radiogra to be fitted with compatible cartrid —something that Philips and Dec for example, have been doing for number of years. There will then no longer any need for mono recor to be marketed. The stereo record c be bought with equal confiden by owners of stereo and mono reco players — though, of course, or the former will reproduce the spat effect imparted by the twin channe The EMI records will be norm stereo — they have always dislik the word 'compatible' — but w from July carry some clear statem to the effect that they may be play with a suitable mono pickup.

"It follows from the EMI Pr Release, referred to earlier, that t discussion of compatibility is longer an academic question involvi just a few record importations. Own of stereo equipment are not mu concerned, but all owners of mo record players should take steps ensure that their machine is able track stereo records satisfactorily."

At this point, it is appropriate append a statement by Cosmocord Lt manufacturers of the well known "Acc brand pickup cartridges. The headi itself is significant, in view of the fo going remarks:

STEREO-COMPATIBLE MONO PICK-UP CARTRIDGES

me of the major recording companies nnounced to the trade, in May, 1966, iat as from some future date mono P records will no longer be available. Only stereophonic pressings will iereafter be marketed and these notes ill explain how this change in arketing policy will affect the design nd choice of mono pick-up cartridges.

stereo recording has vertical as well lateral modulations of the grooves. Vhen playing such a record with a iono cartridge, the vertical modulaons are of no interest and normal iono reproduction is provided by the teral modulations. If record wear is ot to be excessive, however, the tylus of the mono cartridge must e capable of moving vertically in ympathy with the vertical modulaons and without undue restraint. This the most important respect in which ie stereo-compatible mono cartridge iffers from the usual type of mono artridge which is designed only for ie playing of mono records.

e restraint imposed upon the moveient of the cartridge stylus is of iree kinds. The **stiffness** of the cartdge mechanism is predominant up about 500Hz. Stiffness is the recipocal of compliance; the lower the ompliance, the higher the stiffness. rom about 500Hz to about 2.000Hz, ie mechanical **resistance** of the cartdge mechanism is the major factor nd at high frequencies still, the -called **tip-mass** is the controlling uantity. Every one of the three forms f restraint must be suitably miniiised in order to produce a satisactory stereo-compatible cartridge. It quite useless, for instance, to achieve dequate vertical compliance on a suposedly compatible cartridge whilst not lso achieving sufficiently low vertical p-mass. A stereo record, if played ith such a cartridge, would suffer ery serious wear.

oubts have been expressed as to vhether high-output mono cartridges an be made stereo-compatible but iese doubts are unfounded. The point that high-output cartridges inevitably ause rather more record wear than heir low-output counterparts but, proided that a high-output and supposedy compatible cartridge produces no nore wear on a stereo record than its on-compatible version would on the quivalent mono record, then that cartidge is truly stereo-compatible. Such artridges are not difficult to produce.

iere are two other main requirements f stereo-compatible cartridges and hey are:

Low Vertical Sensitivity. Although it is vital that the cartridge stylus easily follows the vertical modulation of the stereo records, it is equally important that these vertical stylus movements produce no significant output at the cartridge terminals. For undistorted mono reproduction from stereo records, the vertical sensitivity of the cartridge should be at least 15dB lower than the lateral sensitivity at low and middle frequencies. At the higher frequencies some increase in vertical output is permissible.

Tip Radius. Many mono cartridges are fitted with tips of 0.0007in-0.001in radius but, for the satisfactory playing of stereo records, the tip radius should be no greater than 0.0007in. Stereo-compatible cartridges must, therefore, be fitted with tip radii in the range 0.0005in-0.0007in.

EDITOR'S NOTE: Amplion (A'sia) Pty. Ltd., of 29 Major's Bay Rd, Concord, N.S.W. are representatives in Australia of Cosmocord Ltd. They advise that, as from the beginning of this month, July 1, the GP 91-1 cartridge (medium output crystal) and the GP 91-3 (high output crystal) will be supplied with stereo compatible diamond styli. These cartridges may be used to play stereo records with no more wear than would be normal for any other cartridge involving the same order of output and tracking weight. Though not confirmed at the time of writing, it would seem logical to assume that similar remarks would apply to the equivalent ceramic cartridge GP 92-1 mentioned in our review, January, 1967, p. 97.

WHO WAS ANNIE LAURIE?

Listeners to the B.B.C. General Overseas Service "Scottish Magazine" program recently heard from Gordon Irving that "Annie Laurie" is the most popular love song in the world today. Annie really was flesh and blood, and Maxwelton House still stands, not far from Penpont village in Dumfriesshire; her boudoir is a delightful old world alcove on the first floor, and dew still lies on the gowan daisies along the "bonnie braes."

The composer of the song was William Douglas, a young army captain, born in 1672. He came from Kirkcudbrightshire in the south-west of Scotland, and fell in love with Anna Laurie of Maxwelton, and immortalised her in this song. But Douglas did not marry his Anna. Perhaps she jilted him, or her parents objected; he married Elizabeth Clark from Lanarkshire, and Anna married a rich young man, Colonel of the Horse, in the army of William III, Alex Fergusson, the owner of a goodly house not far from Maxwelton Braes. It is often thought, even by Scots, that Robert Burns wrote "Annie Laurie," but it was humble William Douglas, her unsuccessful suitor. Later, Lady Jane Scott of Buccleuch came across the verses, added the third verse, and the song caught the public fancy, and has remained popular ever since.

Classical reviews

By JULIAN RUSSELL

Lively and sensitive "Water Music"

HANDEL—Water Music (Complete). Hague Philharmonic Orchestra conducted by Pierre Boulez. Concert Hall Stereo SMS2379.

In terms of the publicity he receives Pierre Boulez is the world's leading avant-garde composer of the 1960s. Boulez, by the way, is a modest man who doesn't go out of his way to seek publicity. The nature of his work brings it to him, for composing is far from being his only activity in the musical world. He is a conductor of wide European repute, as at home in the playing of the romantic school (Wagnerian operas) as he is in the conducting of the works of his contemporaries. Moreover I have heard him conduct — among the music of other schools — that of his compatriot Debussy with a sensibility unmatched, and certainly not excelled, by any other conductor alive or of recent memory.

In addition to these activities he holds classes for advanced composition in several European cities during the course of the year.

Yet, knowing all this about Boulez, I must still confess astonishment at having found his name associated with Handel's "Water Music." This seemed to me to be right out of the run of his multiple interests. And I was still more astonished when, after having played only a few bars, I realised that I was in for a rare treat in a performance that was at once lively, sensitive, and perhaps, more importantly, essentially muscular. In fact, I did something that rarely happens when I listen to a record for the first time in order to review it. I stopped it, and repeated movements just for the sheer pleasure of hearing them again as soon as possible.

"Style" during the last generation has become a highly controversial feature in the performance of eighteenth century music. Double-dotting, the frequent use of unmarked appoggiaturas, trills, acciacciaturas and other ornaments are now added to the bare bones of the score in an attempt to reproduce the music "as it was originally played." And although these activities have the approval of, and are often initiated by, scholars such other important factors as the considerable rise in pitch since the eighteenth century which has put works into higher keys than those in which they were originally written, and the equally important change in timbre of many of the wind instruments, are ignored, and there are still arguments, many of them bitter — and some supercilious — about the authenticity of modern editions.

The sleeve notes state that the edition offered by Boulez is complete and I suppose that might be safely accepted. Three suites are included, in F Major, D Major and G Major. Unfortunately no reference is made to the origin of the edition, but that doesn't trouble me one tiny bit. For whatever it is it sounds fine—good enough to relieve me of the burden of any academic argument on its account. And the playing of the Hague Philharmonic under this versatile musician is in turn exhilarating, beguiling, and immensely impressive. The execution of the many trills and other decorations are faultlessly neat and crisp, and in some way or other Bou'ez has managed to make the woodwind seem to recreate eighteenth century timbre in the sounds they produce from their instruments. The horns chuckle merrily in some movements and supply support of grand solidity in others. As to the strings, they can assert themselves without pugnacity whenever necessary or reduce their tone to a murmur without losing quality in passages where they are asked to do no more than accompany. One of the most important requirements in music of this kind, in which every suite is made up of contrasting movements, is a judicious choice of tempos used in a way that sets one off against another. Boulez' tempos are exquisitely judged with this in mind and his rhythms full of bounce.

There is plenty of presence in the good, clean-cut engineering and I, for one, don't expect to hear a more enjoyable account of the suites than this in the foreseeable future.

* * *

HAYDN — Symphony No. 100 in G (Military).
Symphony No. 102 in B Flat.
New Philharmonia Orchestra conducted by Otto Klemperer. Columbia Stereo SAX05266.

My remarks about Boulez' sprightliness in his playing of the eighteenth-century music noticed above might be more easily grasped if, after having heard them, you put on these two Haydn Symphonies conducted by another musician of still more impressive credentials as a conductor, Otto Klemperer. Klemperer, in these two symphonies, uses one of the world's finest orchestras, the New Philharmonia, and they play for him with all the generosity of which they are capable — and that is plenty. But the overall effect is one of serious application to the task in hand without any trace of the manifest enjoyment in their work that their Dutch colleagues under Boulez introduce into the Handel.

While this treatment can, if you're temperamentally compatible to it, be condoned in the B Flat, which is probably the "biggest" of Haydn's symphonies, the "Military" was conceived and written in much lighter mood and need not have been delivered quite so ponderously. Make no mistake, the orchestral playing is never less than great. It's the atti toward this essentially graceful m that makes me regret more than u the passing of a conductor like Beecl who knew so well how to endow it a lift that not only made one n conscious of its countless ingenuities added to it a dimension absent in Kl perer's reading. But then, Beech Haydn was never approved by the tral European School, the member which were always dismissing it as pant. If you are of the same mind t Klemperer performances should suit very well. In any case the sound is —though the composition of the o estra sometimes hints at a rather n weighty body of strings than is custon in such music—and the players' ex tion unexceptionable.

* * *

BEETHOVEN—Concerto for Violin Orchestra, Op. 61. Yehudi Men (violin) and New Philharm Orchestra conducted by Otto K perer. HMV Stereo OASD2285

The tendency of Klemperer to pon ousness, noted above was, I was prised to find, communicated to Men in his new recording of the Beeth Violin Concerto. It is Menuhin's fo recording of the work. He has pl it twice with Furtwangler—once supe —and again with Silvestri, in which evinced some tenseness. This was bably because of interpretative diff ties that cropped up between the for Silvestri is a very mercurial music as may be remembered by those heard him during his Australian some years ago when, at one concert chopped about ten minutes off the u performing time of the "Eroica."

But in this performance Menuhi —and I can think of no other wo ponderous, for the first time in my experience of his work. Menuhin is 50, but his recent recordings show signs of any loss of the spontaneity lyricism I had hoped to find in his Beethoven. Klemperer's must be a strong influence indeed to have resu in a first movement so rigidly discipli

The Largo is, on the whole, be but, give and take a few eloquent sages, I found little even here to t me. And perhaps the most disappoin movement of all three is the last, Rondo, which I know Menuhin make bounce along as daintily as could wish, but which, this time, so very flat and wooden. Does Men feel the work nowadays the way he p it here, or was "the old man's" sonality too much even for him at hearsals? I'd love to find out.

* * *

BRUCKNER—Symphony No. 7 i Major. Hague Philharm Orchestra conducted by Schuricht. Concert Hall St SMS2394.

Bruckner, if played with pious sol nity — and there are many temptat to introduce such an atmosphere the music of this very godly man can be one of the greatest bores I kr But this is something that Schuricht ways carefully eschews in his n readings of Bruckner. His tem though often a shade faster than other Brucknerian conductors, never gest disrespect. Indeed he can even along a movement like the well-kn Adagio in this symphony without conveying the idea of irreverence.

His Scherzo spins along like a Vien-
:se waltz, at a pace that even the most dulgent might for a while think ex-ssive until a beautiful sensuous Trio ction provides just the right contrast balance everything into a nice formal .ttern. And his Finale comes as close jauntiness as it is possible to make sound, again without any disrespect-l suggestions. This record, by the way, is awarded the French Grand Prix du isque, an unusual distinction for a ·uckner work from a French jury, for ·uckner is practically unknown in ·ance.

The recording was made in 1963 when :huricht had already turned 80. But ere is no evidence of any slackened tality in his control of the orchestra. deed two years later I heard him in olland conducting the Hague Philhar-onic Orchestra in the Scheveningen ursaal. Schuricht was then badly ippled and had to be helped on to the atform supporting himself by two bow-length crutches. With some ef-ırt he got himself propped up against e rostrum and went on to conduct ; fine a performance of Brahms' D [ajor Symphony as any I can remem-:r. The grand old fellow died only st year. The sound quality in this oncert Hall issue is excellent.

* * *

RUCKNER—Te Deum. Teresa Stich-Randall (soprano); Sonja Draksler (contralto); Murray Dickie (tenor); Frederick Guthrie (bass). Vienna Youth Choir. Vienna State Symphony Orchestra conducted by Heinz Wallberg.

[AHLER — Kindertotenlieder. Hilde Rossel-Majdan and Vienna State Symphony Orchestra conducted by Heinze Wallberg. Concert Hall Stereo SMS2442.

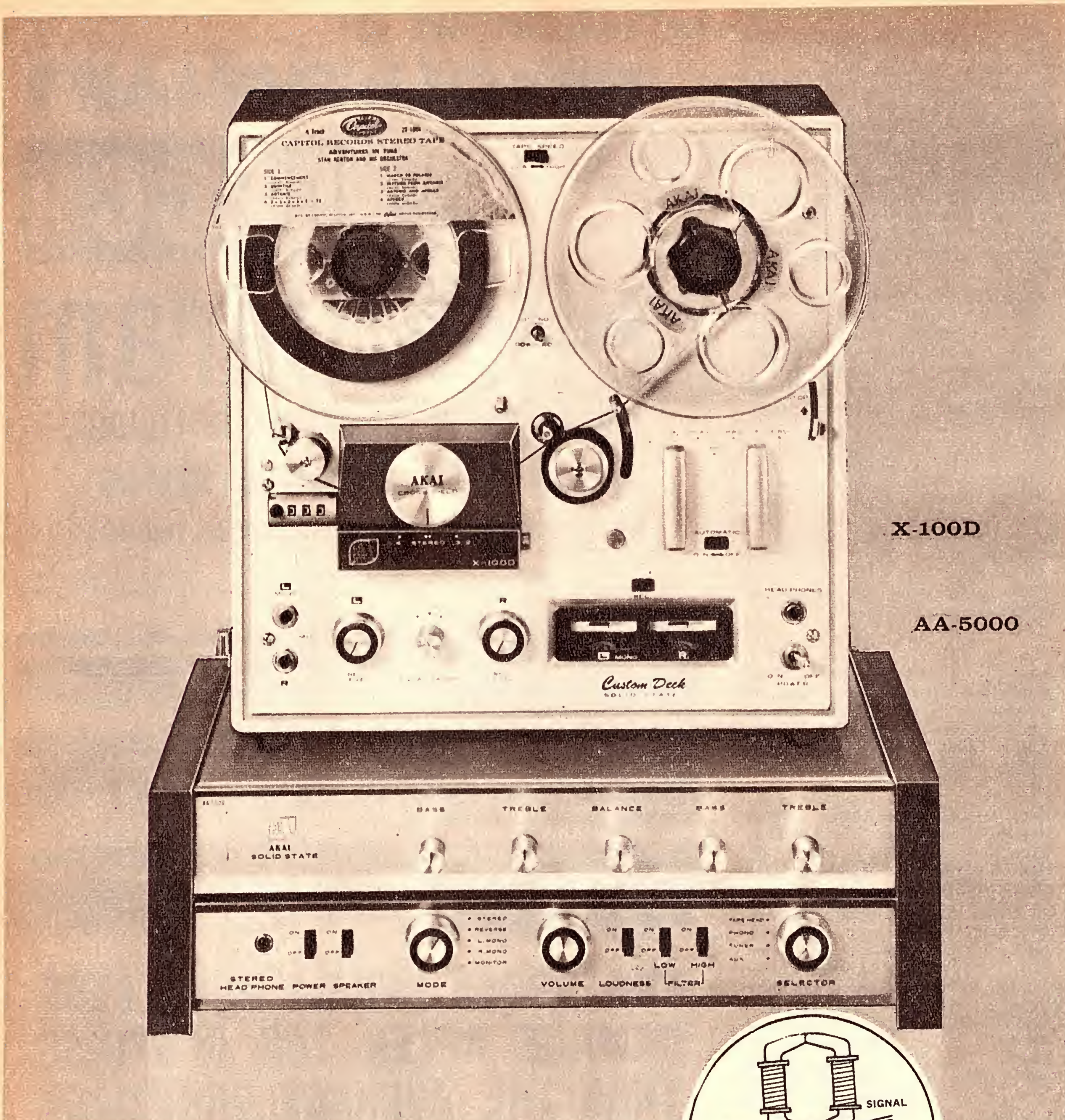
I am afraid that I cannot recommend is performance or recording of Bruck-:r with anything like the same en-ıusiasm. Both the playing and en-neering are heavy-handed and the choir impressive only in the quiet passages. nd even here the basses sound too ght to balance the other members of ıe choir. Teresa Stich-Randall sings ıjoyably for the most part and Murray ·ickie has a pleasing tenor voice. The :her soloists are unimpressive.

The Mahler is in every way better. ı this Hilde Rossel-Majdan's voice is ·oduced with admirable evenness ıroughout its range with a very attrac-ve reediness in the low register. Her :ading of the songs is simple and un-fected without an arch moment. The alance between the soloist and orchestra consistently stable, but the engineering cks bloom, a fact you can easily check y playing the last song. Unfortunately o copy of the songs' texts accompanies ıe record, which people unfamiliar with ıem might find inconvenient.

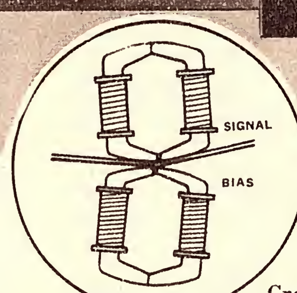
* * *

·VORAK—Symphony No. 6 in D Major, Op. 60. "Carnaval" Overture, Op. 92. London Symphony Orchestra conducted by Istvan Kertesz. Decca Stereo SXL6253.

Decca have embarked on a project to :cord all the Dvorak symphonies with .ertesz and the London Symphony. This the first to reach Australia—and very npressive it is. The work is strongly,



THE SENSATIONAL *CROSS-FIELD HEAD* EXCLUSIVELY PRODUCED BY AKAI



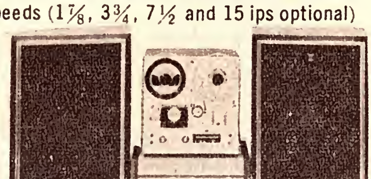
Cross-Field heads

People throughout the world have come to really enjoy this particular feature, because of the superb results.
The Cross-Field System is actually composed of two heads facing one another and so mounted where by their centers are slightly off, as shown in the diagram. This combination of bias and signal heads makes possible clearer responses than the ordinary conventional head, even at slow tape speeds. Therefore, any tape can be modulated over the entire spectrum with maximum fidelity.

MODEL X-100D SOLID-STATE STEREO PLUS CROSS-FIELD HEAD CUSTOM DECK * 4 track stereo monaural record playback * 4 speeds ($1\frac{7}{8}$, $3\frac{3}{4}$, $7\frac{1}{2}$ and 15 ips optional) * Frequency response—30 to 23,000 cps at $7\frac{1}{2}$ ips

MODEL AA-5000
110 WATTS SOLID STATE STEREO PRE-MAIN AMPLIFIER

* Silicon power transistors * Electronics protection circuit * Filters for high and low * Completely O.T.L. system



* SPEAKER SYSTEM SW-130

AKAI
TAPE RECORDER

AKAI ELECTRIC CO., LTD
HIGASHIKOJIYACHO OHTA-KU TOKYO JAPAN

N.S.W.: Magnecord Australasia Pty., Ltd. 210 Clarence St., Sydney Victoria: Magnecord Sales Service, 3-Albury Rd., North Balwyn Queensland Chandlers Pty., Ltd. 399 Montague Bd., West End Brisbane S.A.: Magnecord Sales & Service, 8 Arthur St., Unley W.A.: Tedco Pty. Ltd., 579 Murray St Perth not overwhelmingly, influenced by hms and abounds in easily rememed but never commonplace melodies, rhythms much sprightlier than any r devised by Brahms himself. It also ws Dvorak already a master of the a, the ending of a movement by a cogent, exciting bars.

lthough Kertesz is Hungarian by h he knows just how to get that lilt the playing that only the finest conductors of Czech music—and most those native born—seem able to do. spite an occasional Brahmsian thicken- of the inner voices of the orchestra general effect is one of great brilice. And Kertesz and the L.S.O. have been together long enough to have yed themselves into complete accord, any rate in this type of music.

f you know Dvorak only by such rks as the "New World" and the mphonic Variations for Orchestra," e is a piece that should win the affec- of anyone looking for something from an old, but seldom visited, nd. And for good measure there is "Carnaval" Overture, as fiery as any- could desire and, if a trifle on the wy side, not a whit the worse for that son. Everyone in the orchestra seems be enjoying themselves hugely, as I . Strongly recommended.

★ ★ ★

'ORAK—Symphony No. 5 (No. 9, new style) in E Minor, Op. 95 (From the New World). "Carnaval" Overture, Op. 92. Philharmonia Orchestra conducted by Carlo Maria Giulini. Encore, Stereo S330EX9261.

'ORAK—Symphony No. 5 in E Minor, Op. 95 (From the New World). Chicago Symphony Orchestra conducted by Fritz Reiner. RCA Victrola VICS1155.

can also recommend the Giulini permance of this, the most popular of all orak's symyphonies, originally resed as a Columbia recording but now ilable on the low-priced Encore label. ulini does not perhaps glitter quite so ghtly as Kertesz but still manages to the symphony with more than the rage amount of excitement, and this hout any freakish accenting or wild npos. Perhaps the greatest difference the two conductors' approach to this nposer is Kertesz' spontaneity. Giulini es the impression of having studied work more carefully, perhaps because his Latin origin, though he always oids any hint of staleness, or even dantry.

Moreover he manages to win some autifully warm sounds from his chestra without sentimentalisation of music, even where this can be so sily added, as in the cor anglais theme the famous Largo. There is a slight idency, which I noticed more in the herzo than elsewhere, to record the odwind just a trifle larger than life. herwise the sound is first rate. And this disc, too, you have a rousing rformance of the "Carnaval" Overture t might lack ever so little of Kertesz' arkle, but is eminently exhilarating vertheless.

After listening to this performance I d it difficult to recommend anything out the Reiner version. Reiner makes orak sound much too formal in comrison to the two other conductors menned above. The whole of RCA's disc devoted to the "New World" without a fill. The engineering is efficient but sometimes the sound is a little woolly.

★ ★ ★

THE ELISABETH SCHWARZKOPF SONG BOOK. Songs by Schubert, Schumann, Wolf, Debussy and Rachmaninoff. Seven Songs from Wolf-Ferrari's "Italian Song Book." Sung by Elizabeth Schwarzkopf (soprano) with Gerald Moore (piano). Columbia Stereo SAX-05268.

The Schubert and Schumann songs in this deliciously relaxed recital will probably all be known to most readers interested in lieder. In the Schubert group you will find "Der Einsame," 'Der Jungling an der Quelle," "Die Forelle," "Heidenroslein," "Claudine von Villa Bella," "Liebe Schwarmt auf Allen Wegen," and "Seligkeit." In the Schumann, "Myrthen," "Widmung," "Leis' Rudern hin," and "Wenn durch die Piazza." The Hugo Wolf, too, should be fairly familiar, "Wenn du zu den Blumen gehst," and "Die Zigeunerin."

But there won't be many who have heard of the Wolf-Ferrari bracket before. They are settings of Tuscan folk poems, some gay, some scornful — in fact you'll find them in every mood that you'll find lovers — in verse. All are entrancingly tuneful, a fact that will not surprise those who know the composer by his operas, "The Secret of Susannah," and "The Jewels of the Madonna." Schwarzkopf sings them with endearing simplicity and utterly without condescension. But there is one, in which a girl seeks a dead lover, that Schwarzkopf makes sound very dramatic indeed, a reminder of the great gifts of characterisation she uses to such good purpose in opera.

In the whole of the recital there was only one song that disappointed me — Debussy's "Mandoline," in which, though Schwarzkopf herself seems far from confrontable, there is the compensation of Gerald Moore's exquisite accompaniment. Moore is his usual incomparable self throughout. And though I haven't mentioned it so far, the recital ends with a performance by the two artists of "Danny Boy" that is so surprisingly beautiful that it may well bring you to reconsider the quality of this melody, debased though it has become by banal associations.

★ ★ ★

DELIUS—Concerto for Cello and Orchestra. Jacqueline du Pre (cello) and Royal Philharmonic Orchestra conducted by Sir Malcolm Sargent.

Songs of Farewell (for double chorus and orchestra) Royal Choral Society and Royal Philharmonic Orchestra conducted by Sir Malcolm Sargent.

A Song Before Sunrise. Royal Philharmonic Orchestra conducted by Sir Malcolm Sargent. Record Society S6223.

The soloist in this is the very gifted young English girl who recently made so impressive a recording of the Elgar Cello Concerto. And her performance of the Delius is just as eloquent, youthfully romantic but never fulsome. The work itself, for the most part, is serene and placid with its single reaching towards a climax subsiding before it achieves a catharsis. It is all beautifully lullir music — if you are prepared to gi yourself up to it without too much cri cal reserve. It is the Delius of "Bri Fair" though that is, to my mind, far superior work. The concerto is tl sort of work you can listen to comfo ably while thinking of something els There is nothing showy in the solo pa Not even a cadenza. But it goes on thought too long in the same vein. Tl engineering is adequate, but no more.

The "Songs of Farewell" set words l Walt Whitman to mellifluous sound, w performed by both singers and orchestr but I must add a special word of prai for the deliciously played epilogue by tl orchestra.

"A Song Before Sunrise" was dedica ed to Delius' young friend and pr tege, Phillip Heseltine (Peter Warloc and is an enchanting aubade, expressi perhaps as well as anything Delius ev wrote, his deep pantheistic love of eart In form it is small, even miniature. B it is unremittingly shapely, tend colourful and seraphic. It is play with manifest affection by Sargent a his orchestra. And now that Deli name has started to reappear on the r cord catalogues after much too lo an absence, perhaps we can look fo ward to re-recordings of such fine wor as "Appalachia," "Paris," "A Mass Life," "Brigg Fair" and others?

* * *

MUSIC OF SHAKESPEARE'S TIM A collection of over 40 songs a instrumental pieces with Wilfr Brown (tenor), Eileen Poult (soprano), Darien Angadi (b soprano), Mary Thomas (soprano Patricia Clark (soprano) and othe The Dolmetsch Consort. Soloists a Viols of the Schola Cantorum Ba liensis and others. Record Socie Stereo S6217/8.

This is a most enjoyable antholo compiled and in some cases edited the lutenist Diana Poulton who was doubt prepared to receive the criticis aimed at all anthologists — the i clusion of some items and the omi sion of others. To my way of thinki she has done an excellent job in a sembling two discs of music for tl most part attractive, and never less th interesting. But in a program of tl length there was bound to be some th appealed more than others. On tl whole the two are unfailingly entertai ing.

The eight soloists sing their vario contributions with skill and good music taste. Instruments used in other piec include viols, lutes, virginals, recorde tabors and others of more recent origi That many of these are played by t Dolmetsch Consort will ensure pr pective buyers of the quality of the p formances.

Not all the pieces are to be fou in Shakespeare's plays. Don't be s prised if a few are not even mention in them, and were included on t grounds of only the most distant r lationship. You will even find sor early Jacobean pieces in this elegant r cital. You may, too, be mislead by tl numbering of the various items in t sleeve notes (which, by the way, a satisfyingly informative both to schola and tyros) but a glance at the reco labels should very soon put things rig for you to settle down to some ve enjoyable listening.

DOCUMENTARY RECORDS

Reviewed by Glen Menzies

HE LEGEND THAT IS LAWSON: Read by John Clements with John Manifold and his Bandicoots. W. & G. L.P. 25/5006.

With such a scarcity of Australian aterial in the spoken word field, it is pleasure this month to be able to de- ɔte the whole of this space to two P.'s featuring some of the best work two of our most widely read poets. was only the other day that a letter the daily Press questioned whether ıything was being done to commemo- te the centenary of the birth of Henry ıwson. This record released just in ne for Lawson's birthday on June 17th akes a very good start.

Henry Lawson was born in a tent on goldfield at Grenfell in N.S.W., in 367. His father was a Norwegian ıartermaster, turned digger, carpenter, ntractor and settler. His mother, ıo looked after the local store and post ice, was a remarkable woman who er became a pioneer in the feminist ɔvement and founder and editor of a agazine for women's rights. It was from r that Lawson's literary im- lses came. Educated at the Eurunde- e State School, his childhood was mar- l by the onset of deafness at the age nine and an unhappy home life caused the conflicting temperaments of his rents. He worked on the family selec- n and at casual bush jobs and later ɔved to Sydney with his mother where became apprenticed to a coach build-

Inevitably, Lawson became one of the ɔwing army of job seekers, but in meantime he was writing verse and ing to get it published. It was not til he reached the age of 20, when e of his verses was published in the ulletin," that his literary career began l he turned more and more to writing a living. The decisive event in his life, wever, was when the "Bulletin" sent n off on a six months tramp from urke to Hungerford on the Queens- ıd border. Lawson was 25 and out of s experience came the inspiration for ne of his best work.

The 14 ballads in this album include ıny from this period. They reflect Law- ı's compassionate nature, and his feel- ; for humanity, which is often tinged h a note of loneliness and melan- ɔly, as in "The Sliprails and the Spur," ndy's Gone With The Cattle." The acity of man and beast is conveyed the slogging test of endurance depict- in "The Teams." In contrast to these re is the wonderful onward momen- n of one of the poet's happiest in- rations, "The Lights of Cobb & Co.," l the lyrical and romantic charm of eedy River."

The theme of social protest is upper- ɔst in "Faces In The Street" a "poem revolt" against the social ills of Aus- lian city life which still makes a werful impact with its sincere impas- ned utterance, quote:

"They lie, the men who tell us,
for reasons of their own,
That want is here a stranger, and
that misery's unknown."

Also on a note of protest, but with a "Chaplinesque" touch and a measure of sly humour, is the well known, "When Your Pants Begin To Go." Another good choice is "Middleton's Rouse-about," a short, but clever character sketch of a "drongo" type who eventually takes over his boss' property.

This is a well chosen selection which will help to make new friends for the poet and may encourage some to look further into his short stories — an area in which Lawson is acknowledged as one of Australia's greatest writers. In what seems a rather odd arrangement, the first ballad on each side of this record is sung by solo voice with guitar, on side one a woman's voice of somewhat foggy quality, and on side two a rather better male voice. I feel that these could have been dispensed with entirely, in view of the very capable and professional reading by John Clements who makes no attempt to be aggressively Australian but takes a straightforward approach, with a little dash of characterisation when called for by the poems themselves.

★ ★ ★

BEST OF BANJO PATERSON: Read by John Clements with John Manifold and his Bandicoots. W. & G. L.P. 25/5003.

This album makes an ideal companion to the "Lawson" and gives the listener the opportunity for a direct comparison of the two poets' styles. But there is no question of Paterson and Lawson being diametrically opposed to each other. They are, indeed, viewing the same landscape through different eyes; the differences in outlook arising from matters of temperament, upbringing and experience of life. Banjo Paterson himself put it this way, "We were both looking for the same reef — but I had done my prospecting on horseback with my meals cooked for me, while Lawson had done his prospecting on foot and had had to cook for himself."

Although most of us live in an urban environment in this country, these ballads still have a unique way of evoking for us the atmosphere of the Australian countryside and man's place in its landscape. Paterson gathered material from a widely scattered community which included cattlemen, sheepstealers, shearers and drovers, the small township with its bush pub, the country race meeting and that indispensable animal, the horse.

Banjo Paterson's technical mastery of his chosen medium is quite apparent here with "Clancy of the Overflow" which begins the recital. This poem is now so famous that it can be all too easily taken for granted; that is, until one once again falls under the spell of:

And the bush has friends to meet him,
and their kindly voices greet him,
In the murmur of the breezes and the
river on its bars,
And he sees the vision splendid of the
sunlit plains extended,
And at night the wondrous glory of
the everlasting stars.

And equally, one can't fail to be caught by the gusto of "The Man From Snowy River" which gave the title to Paterson's first book published in 1895, a remarkable best seller with 10,000 copies sold in the first year. The story of another hair raising ride, and one which puts mechanical means of transport finally in their place, is "Mulga Bill's Bicycle."

Several of the ballads here reflect the writer's dry ironic humour and feeling for a well-told tale in the form of an anecdote, e.g., "The Bush Christening," "The Geebung Polo Club" and "The Man from Ironbark" with its wonderful description of the idlers in the barber's shop:

There were some gilded youths that
sat along the barber's wall.
Their eyes were dull, their heads were
flat, they had no brains at all.

I listened with amused fascination to the "Disqualified Jockey's Story;" here the poet reveals a perfect ear for the sound of a character and a special feeling for action in the description of the running of the rigged race. But in "The Traveling Post Office" I found quite touching the faith in country communication out on the central western plains where mail is just addressed "c/o Conroy's sheep."

The 12 poems in this recital give an exciting and satisfying glimpse of Banjo Paterson's talents as a balladist, and offer a variety of challenges to the reader with marked differences of pace, inner contrasts and possibilities for drama and character depiction. John Clements once again does very well in making the most of the material; these are sympathetic readings with the right touch of warmth and informality. Microphone placement is intimate but never overpoweringly so.

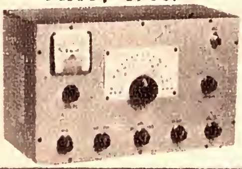
I am sorry that the texts of the Lawson and Paterson poems were not included. Even roneoed copies would be better than none at all. As on the other album, the first tracks on either side are sung; side 1, "A Bushman's Song" by a male singer and side 2, a very disappointing version of "Waltzing Matilda" by a female singer. At the moment there are far too many recordings of this song by indifferent singers, and as it still remains one of Banjo Paterson's most inspired creations I feel it deserves much better treatment.

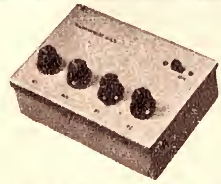
These two albums are major additions to the local spoken word catalogue and have the added attraction of being released on the W. & G. Blue Label series which are bargain priced at $2.50 each.

K I T S

Public Address Units — Geiger Counters — Metal Locators — Decade Boxes — Mixers — Battery Chargers — Oscillators — Bridges — Parts Supplied for Projects in Electronics (Aust.), Wireless World, Practical Wireless, Electronics World, Electronics Illustrated, Practical Electronics, etc.

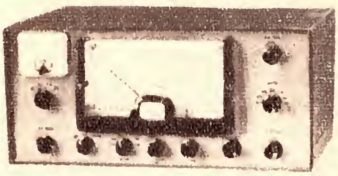
3-BAND DOUBLE CHANGE RECEIVER,
MAY, 1966.





4-CHANNEL AUDIO-MIXER,
FEB., 1966-1967.

5-BAND DSB TX,
NOV., 1965.



INSTRUMENTS.
1 5in Wide Range C.R.O.
2 * 3in F/C C.R.O.
3 3in C.R.O. (1966).
4 C.R.O. Elecronic Sw.
5 C.R.O. Wide Band Preamp.
6 Standard Audio C.R O.
7 Project Multimeter 20K/V.
8 Meterless Voltmeter.
9 Millivoltmeter (A.C.).
10 Trans Millivoltmeter (A.C.).
11 Noise-Distortion-Millivoltmeter.
12 VTVM.
13 1966 — VTVM.
14 * 1960 Audio OSC.
15 * 1962 Audio GEN.
16 6-Band OSC. RF and AF.
17 Trans Service OSC.
18 STD. Audio OSC.
19 Trans Audio OSC.
20 D/R A/F Meter.
21 Simple Signal Injector.
22 Trans Signal Tracer.
23 Trans Wave Meter.
24 G.D.O. Adaptor.
25 Wide Range G.D.O.
26 1966 Basic Test OSC.
27 Square Wave GEN.
28 XTAL Locked STD.
29 Electronic Tuning STD.
30 Pattern GEN.
31 Trans Pattern GEN.
32 5.5 and 36 MHZ Sweep GEN.
33 Sweep and Marked GEN.
34 Silicon Diode Sweep GEN.
35 Silicon Diode Noise GEN.
36 * R.C. Bridge.
37 1966 R.C. Bridge.
38 Geiger Counter.
39 Direct Reading Impedance Meter.
40 Simple Proximity Relay Alarm.
41 Electronic Anemometer.
42 * Light Beam Relay Alarm.
43 Electronic Stethoscope.
44 * Valve and Transistor Tester.
45 Resonance Meter.
46 Moisture Alarm.
47 Trans Alarm.
48 Flasher Unit.
49 Photo Timer.
50 Pipe and Wiring Locater.
51 S.W.R. Indicator.
52 Electronic Pistol Range.

BATTERY CHARGERS.
53 Universal Battery Charger.
54 Battery Charger—1 AMP.

REGULATED POWER SUPPLIES.
55 Trans REG. 9v P/Sup.
56 Trans Fully Protected.
57 1966 H.T. REG. P/Sup.

VOLTAGE/CURRENT CONTROL UNITS.
58 Model Train Control Unit.
59 Vari-Watt Power Controller.
50 Vari-Tach Motor Speed Control.
51 2KW—Automatic Light Dimmer.
52 4KW—Automatic Light Dimmer.

TACHOMETER.
63 6 or 12 Volt Kit.
64 * 6 or 12 Volt Mullard.
65 6 or 12 Volt Tach and Dwell Angle.
66 Tach and Dwell Angle Unit for Service Stations.

TRANSISTOR IGNITION.
67 6 or 12 Volt (RO-FO).
68 6 or 12 Volt Ign. (TX type).
69 Automotive V/Meter.

DC-DC CONVERTER.
70 DC-DC 60 W.
71 DC-DC 40 W. 12V IN.
72 DC-DC 70 W. 12V IN.
73 DC-DC 100 W. 12V IN.
74 DC-DC 140 W. 24V IN.
75 DC-DC 225 W. 24V IN.

HIGH FIDELITY AMPLIFIERS.
MONO UNITS.
76 HI-FI 3.
77 Mullard 3-3.
78 Mullard 5-10.
79 Mullard 2-20.
80 * Wireless World 20-20 20w. (Trans.).

STEREO UNITS.
81 Mullard 3-3.
82 Mullard 5-5 (Trans.).
83 Mullard 10-10 (Trans.).
84 Mullard 10-10.
85 * Wireless World 20-20.
86 Playmaster Unit 3.
87 Playamster Unit 9.
88 Playmaster Twin 10.
89 Playmaster 101.
90 Playmaster 105 (Trans.).
91 Playmaster 113 (Trans.).
91A Playmaster 115 (Trans.).

P.A. and GUITAR. AMPIFIERS.
92 10 Watt Stand. or Guitar.
93 25 Watt Standard.
94 35 Watt Standard.
95 100 Watt P.A.
96 25 Watt Guitar.
97 35 Watt Guitar.
98 50 Watt Guitar.
99 20 Watt Golden Series.
100 Playmaster 102 Guitar.
101 Playmaster 103 Guitar.

CONTROL UNITS AND PREAMPS.
102 Playmaster No. 9.
103 Playmaster No. 10.
104. Playmaster No. 104.
105 Playmaster No. 111.
106. Playmaster No. 112.
107 Philips M'Watt Unit.
108 Mullard 2V. Unit.
109 Mullard 3V. Unit.
110 Mullard Preamp and W/B Tuner.
111 Transistor Mono Preamp.
112 Transistor Stereo Preamp.
113 Sil/Trans. Mono Preamp.
114 F.E.T./Trans. Mono Preamp.
115 F.E.T./Trans. Stereo and Preamp.
116 DYN MIC. PREAMP.
117 4-CHAN. Audio Mixer.

TUNERS.
118 P'master Unit Style.
119 P'master 114.
120 Mullard Wide Band Tuner and Preamp.
121 Philips M'watt Hi-Quality Tuner.

RECEIVERS.
122 Fremodyne 4.
123 Communications RX.
124 Deltahet RX.
125 1965 Communications RX.
126 Amateur Band 10.
127 3-Band D/Change S/Het.
128 * 1967 Interceptor 5.
129 ALT. T'sistor Car Radio.
130 Transporta 7 (RF).
131 Little General 1961.
132 3 Band 8 Transistor.
133 3-Band 3- (AC).
134 Interstate 5 (AC).
135 All Wave T'sistor 3.
(* Kit Release Date — August 1967.)

TRANSMITTERS.
136 144 MHZ Linear Final (50w).
137 144 MHZ TX (20w).
138 144 MHZ TX (75w).
139 144 MHZ TX (18w).
140 144 MHZ S.S.B. TX.
141 3-Band AM. TX.
142 Basic 3-Band TX.
143 5-Band DBS TX.
144 S.S.B. T.

V.F.O. UNITS.
145 Remote V.F.O.
146 769 HF and VHF.
147 All Transistor.

MODULATORS.
148 Modulator 50w.
149 MOD-PA and P/Supply Unit.

CONVERTERS—RECEIVER.
150 Short Wave Unit.
151 2-Band S/Wave Unit.
152 3-Band S/Wave Unit.
153 Basic S/Wave Unit.

STILL A TOP FAVOURITE . . .

Enjoy your leisure time and build

Excellent frequency response. Low distortion figure. High input sensitivity. All controls self-contained. 10 watts per channel.

MINIWATT TWIN 10 STEREO — COMPLETE KIT $79.50

LARGE STOCKS OF — SPEAKERS, TRANSFORMERS, RECORD PLAYERS, TAPE DECKS, VALVES, DIODES, TRANSISTORS, MICROPHONES, INSTRUMENT CASES, and all other items — write for your price list.

ELECTRONIC DEVELOPMENTS PTY. LTD.

Phones 63-3596
63-5973

232 FLINDERS LANE
MELBOURNE . . . . VICTORIA

Phones 63-3596
63-5973

K I T S — AMPLIFIERS — PREAMPLIFIERS — TUNERS — CONTROL UNITS — GUITAR UNITS — INSTRUMENTS — INVERTERS — CONVERTERS — RECEIVERS — TRANSMITTERS — REGULATED POWER SUPPLY — TRANSISTOR & VALVE TYPES. — **K I T S**

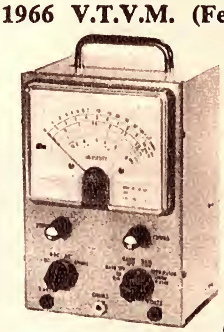
1966 3in C.R.O. (MAY)

118.50

REGULATED POWER SUPPLY 1966 (June)

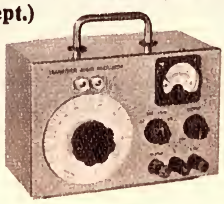
$45.85

1966 V.T.V.M. (Feb.)



$51.50 (5% Res.)

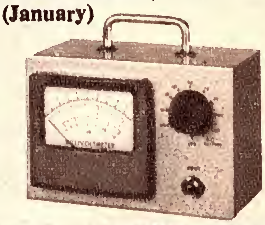
'RANSISTOR AUDIO OSCILLATOR 1965 (Sept.)



$50.25 (inc. sq wave).

SENIOR TACHO and DWELL TESTER. 1964 (October)

TRANSISTOR M./VOLT METER 1965 (January)

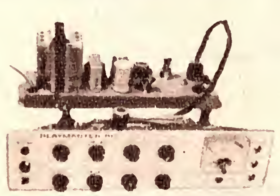


$42.50

POPULAR KITS — TOP QUALITY — LOWEST PRICES

PLAYMASTER UNIT 4 STEREO AMPLIFIER
R.T.V. and H. March 1962
FULL KIT: $72

PLAYMASTER 110 TAPE AMPLIFIER
ELECTRONICS (Aust.), March-April, 1965

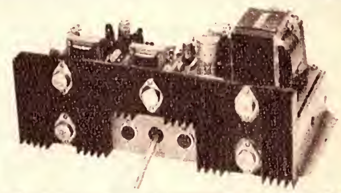


PLAYMASTER 106 STEREO AMPLIFIER with IN-BUILT TUNER, $94.50

PLAYMASTER 111 WIDEBAND TUNER, $78
(October, 1965)

PLAYMASTER 112
December, 1965 **$85.25**

PLAYMASTER 113
March, 1966 **$69.75**



;0 WATT—SOLID STATE GUITAR AMPLIFIER (All Transistor)

.IT SPECIFICATIONS: 60 watts—RMS.
'req. Res. = 20HZ — 25KHZ — ± 1db.
'otal Harm. Dist = Less than 0.8% at rated output.

Input (5) sensitivities. 3mv ± 10mv+ 10mv + 250mv + 350mv.

Write for further details

ALSO AVAILABLE AS A STEREO OR TWIN COMBINATION

ELECTRONIC DEVELOPMENTS PTY. LTD.

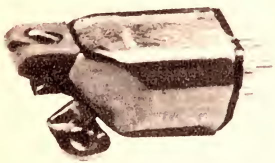
'hones 63-3596
63-5973

232 FLINDERS LANE
MELBOURNE . . . . VICTORIA

Phones 63-3596
63-5973

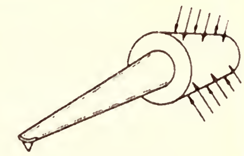
EMPIRE—WORLD'S MOST PERFECT MONO - STEREO CARTRIDGE

Manufactured in U.S.A. *Sole Agents for Australia—TRUE FIDELITY*



EMPIRE CARTRIDGE 888/888P/888PE/888E/888SE

WITH EXCLUSIVE "MOVING MAGNETIC CONE" STYLUS
FEATURING 15 DEGREE VERTICAL TRACKING ANGLE



How to enjoy
the ultimate in
Listening Pleasure
with your new

EMPIRE

MADE IN U.S.A.

888 CARTRIDGE Series

U.S. Patent No 2975262

TECHNICAL SPECIFICATIONS

MODEL	888	888E	888P	888PE	888SE
Frequency Response	10-24,000† cps.	10-30,000† cps.	8-28,000† cps.	6-30,000† cps	6-32,000† cps.
Output Voltage	8.0 mv. per channel	8.0 mv per channel	8.0 mv. per channel	8.0 mv per channel	8.0 mv. per channel
Channel Separation	more than 30 DB	more than 30 DB	more than 30 DB	more than 30 DB	more than 30 DB
Compliance	10×10^{-6} cm/dyne	12×10^{-6} cm/dyne	15×10^{-6} cm/dyne	20×10^{-6} cm/dyne	25×10^{-6} cm/dyne
Tracking Force	¾ to 6 grams	¾ to 5 grams	½ to 4 grams	½ to 3 grams	½ to 3 grams
Stylus	.7 mil radius diamond	.4 x .9 mil bi-radial elliptical hand polished diamond	.6 mil radius hand polished diamond	.2 x .9 mil bi-radial elliptical hand polished diamond	.3 x .7 mil bi-radial elliptical hand polished diamond
Terminating Impedance	47,000 ohms	47,000 ohms	47,000 ohms	47,000 ohms	47,000 ohms
Stylus Replacement	S888/7RD Brown	S888E/ERD Green	S888P/6RD Orange	S888PE/ERD Yelow	S888SE/ERD Blue

†Dynamic capability to 40,000 cps

SPECIAL FEATURES:
15 Degree Vertical Tracking Angl
Exclusive Induced Field Mov
Magnetic Cone Stylus ● Fully c
patible for stereo or mono ● C
plete freedom from hum pickup
Replaceable Stylus assembly ● L
est dynamic mass ● Outstand
stereo channel separation ● V
low tracking force required ●
magnetic attraction to steel t
tables ● Low needle talk ● High
stylus compliance.

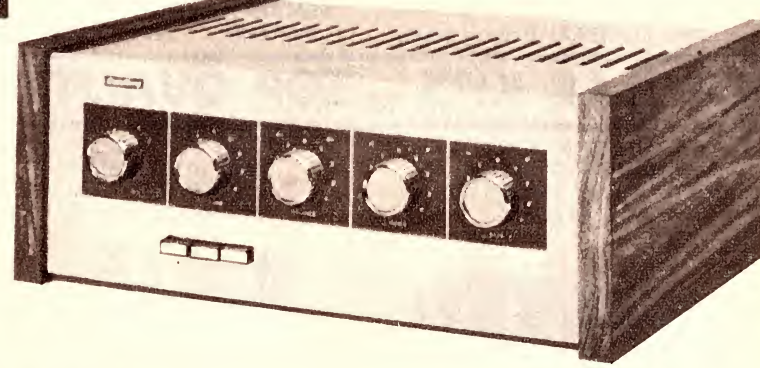
Armstrong

WORLD'S BEST AMPLIFIER

MADE IN ENGLAND

Sole agents for Australia:

TRUE FIDELITY — 23 Collins Street, MELBOURNE



TT1 INTEGRATED STEREO AMPLIFIER
Shown in optional case of solid teak and vinyl-hide.

The 221 Amplifier is designed for use primarily with magnetic pick-ups but inputs are also provided for the higher output ceramic and crystal pickups.

At its price the 221 represents a major break-through in high fidelity amplifiers. Never before has an amplifier of this quality, sensitivity and power, incorporating all these facilities been available in this price range.

TECHNICAL SPECIFICATION

The specification refers to overall performance and this should be borne in mind when comparing figures with amplifiers and control units quoted separately.

Power Output	10 watts push-pull per channel, R.M.S
Frequency Response	30-20,000 c.p.s. ± 1dB.
Power Response	35-20,000 c.p.s.—1dB.
Harmonic Distortion	Less than 0.5% at 1K/cs measured at 8 watts output ± 1dB.
Hum and Noise	55dB below rated output.
Negative Feedback	15dB.
Output Impedance	Alternative 4, 8, 16 ohms.
Transient Response	Rise time 6 micro-secs.
Crosstalk	Better than 40dB.
Channel Matching	± 1dB.
Balance Control	Range of—10dB each channel
Treble Control	+ 15dB.,—12dB, at 10K/cs.
Bass Control	+ 12dB,—12dB, at 70 c.p.s.
Loudness	Switched. Superimposes increase in extreme bass and treble at low volume.
Rumble Filter	—6db at 35 c.p.s. increasing at lower frequencies.
Treble Filter	8 K/cs. with slope of 12db per octave above this frequency.
Input Sensitivity	Five pairs of stereo inputs as follows: Pickup 1, Tape, Radio. 80mV at 2M ohms. Pickup 2 (magnetic pickups) 3.5mV at 50K. Tape Monitor 600mV at 100K.
Tape Recording	500mV output. Low impedance.
Valves & Semi-Conductors	4 x ECL86, 2 x ECC83, 2 x AC107, 2 x OC71 2 x BY114.
Power Supplies	AC 200-250 volts. Dual voltage (100-130, 200-250 volts) to order. Consumption 70 watts.
Weight	Net. 14½ lbs, 6.6 kgs. Packed 19 lbs, 8.6 kgs.

Dimensions		Width.	Depth.	Height.
Chassis	ins.	$12\frac{3}{8}$.	$10\frac{5}{8}$.	$4\frac{3}{4}$.
	cms.	31.4.	26.9.	12.
In Case	ins.	$13\frac{3}{8}$.	11.	$5\frac{1}{4}$.
	cms.	34.0.	27.9.	13.4.
Cut-Out	ins.	$12\frac{1}{8}$.	—	$4\frac{1}{2}$.
	cms.	30.8.	—	11.4.

You need no technical or electrical knowledge to install Armstrong units. The interconnection is simplicity itself and a comprehensive manual, supplied with every unit, gives straightforward instructions for installation and operation. For the technically minded full servicing and circuit data are also given.

TRUE FIDELITY

C. PINCZEWSKI

For complete brochures on the Armstrong and Empire equipment and further information, write to:

***RECORDED MUSIC SALON,* 23 Collins Street, Melbourne. Telephone 63-6257**

Wholesale and trade enquiries welcome

VARIETY FARE

★ "ELECTRONICS Australia"

★ Staff Review Panel

evotional

E BILLY GRAHAM LONDON CRUSADE CHOIR. 2000 Voices. Crusade Choir conducted by Cliff Barrows. Stereo, RCA LSP-3698. Also available in mono LPM-3698.**
Interest: "New" Crusade songs.
Performance: Massive, authentic.
Quality: Good.
Stereo: Impressive spread.

he London Crusade, conducted dur- June, 1966, in Earl's Court, turned to be the most massive and most ›trating of any crusade ever con- ed by the Billy Graham team. il attendance at meetings exceeded 0,000, the largest single meeting at nbley Stadium, supplemented by TV topping 100,000.

lassed choirs are no new feature of crusades but I doubt that any r ever sounded more massive, more uinely spontaneous than these 2,000 es, drawn from London and its en- ns. Not only this, but they have ten completely away from the range hymns that seemed to have become ade "standards" in earlier years.

he London choir sings: Heaven ne Down And Glory Filled My —Praise, My Soul, The King of ven—Hallelujah, Praise Jehovah— n Jesus Came—O Happy Day—Ye es, lift Up Your Heads On High here's A New Song In My Heart urely Goodness And Mercy—I Have ided To Follow Jesus — He's Got Whole World In His Hands—'Tis rvellous And Wonderful—Give To God Immortal Praise.

record I can thoroughly recom- d, particularly in view of Billy ham's approaching visit to Sydney. N.W.)

★ ★ ★

E INCOMPARABLE MORMON CHOIR OF ENGLAND. Conductor, R. H. Barton, Jun. Organist, H. Robinson Cleaver. Stereo, Decca SKL-4819.
Interest: Excellent choir.
Performance: High standard.
Quality: Very good.
Stereo: Effective.

ncomparable" is quite an adjective ive up to, particularly for a choir 300 voices which had practised to- er for only one day prior to the ing of this recording. Incomparable? haps not, but you won't find many er examples of massed voices in the text of Gospel singing. Of special rest is the playing of H. Robinson aver, an organist whose name I have come across for quite some time. the console of the large pipe organ Colston Hall, Bristol, he produces e beautifully phrased accompani- ts, with occasional bass notes that bring a gleam to the eye of any enthusiast.

Not all the hymns are known to me but they are all very acceptable in the context of Gospel music: Let The Mountains Shout For Joy—Sweet Is The Work—The Lord's Prayer—The Builder—Abide With Me—I Walked Today Where Jesus Walked—God Of Our Fathers—Holiness Becometh The House Of The Lord—Eternal Life—Stranger Of Galilee—Thanks Be To God—Love At Home—One World—Come, Come, Ye Saints.

Recorded before a large audience, each number is heard in complete silence but followed by applause and, in one interlude, by a baby's cry which someone must just have stifled until the last notes of the track had faded! Though the exception rather than the rule, the applause lends a "you are there" atmosphere and, incidentally, provides a most impressive demonstration of how stereo can spread sound right across one wall of the listening room.

Yes, an excellent record. (W.N.W.)

★ ★ ★

SWEET HOUR OF PRAYER: The Ray Charles Singers. Stereo, Calendar (Festival) SR66-935. Also available in mono R66-35.
Interest: Favourite Gospel hymns.
Performance: Modest but capable.
Quality: Good.
Stereo: Modest.

Re-released on the economy Calendar label, "Sweet Hour Of Prayer" contains 13 very well known Gospel melodies, sung in simple fashion by what sounds like a fairly small though competent group. Most of the numbers are sung with a minimum of accompaniment but, in one or two, the electronic organ backing reaches somewhat incongruous bass-heavy proportions.

The tracks: Sweet Hour Of Prayer —Softly And Tenderly—In The Garden—In The Sweet By And By—Beautiful Isle Of Somewhere—I Love To Tell The Story—Softly Now The Light Of Day—The Old Rugged Cross —There Is A Happy Land—We Gather Together To Ask The Lord's Blessing—Brighten The Corner—Let The Lower Lights Be Burning—Now The Day Is Over.

Not a record that I could get very enthusiastic about but one that, at the price, could bring pleasure to those interested in simple Gospel hymns, for their own sake. (W.N.W.)

★ ★ ★

WONDERFUL PEACE. Tennessee Ernie Ford with the Jack Halloran Singers. Mono, Capital T-2557.
Interest: Popular singer.
Performance: Vocally excellent.
Quality: Good.

As a singer of Gospel songs, one has come to expect a first-rate performance from Tennessee Ernie Ford and this album poses no exception. Whether singing with backing or a capella or reciting the sacred verse, his voice is full, smooth and rich. Generally, the Jack Halloran Singers also rate a good mention but I was not so happy with the instrumental accompaniment on side 1. In particular, the slap bass seemed altogether too prominent, too "tubby" and too random. In fact, as if the producer had sensed the problem, the same criticism cannot be levelled at side 2.

The hymns, all well known, are Crown Him With Many Crowns—Wonderful Peace—Beneath The Cross Of Jesus—Come, Thou Almighty King —I Love Thy Kingdom, Lord—The Beautiful Garden Of Prayer—Lead Kindly Light—Grace, Greater Than Our Sin—The Name of Jesus—Jesus, Lover Of My Soul—Saviour, Again To Thy Dear Name.

In short, a good disc as far as Tennessee Ernie is concerned but, to my mind, let down somewhat by the arrangements on side 1. (W.N.W.)

★ ★ ★

SPECTACULAR BRASS AND VOICES. Band and Songsters of the Salvation Army Congress Hall. Stereo, ATA (Festival) SATAL-932,195. Also available in mono ATAL-932,195.
Interest: Sydney band, chorus.
Performance: Robust.
Quality: Good.
Stereo: Normal.

This is an album which should find ready and automatic acceptance by all those with a Salvation Army background, or with an ear for the Salvationist style of music. With a history dating back to before the turn of the century, the Sydney Congress Hall Band comprises 40 players drawn from

NEW *Releases!*

IN HI-FI STEREO EQUIPMENT BY CLASSIC

Based on the R. & H. Playmaster 106 an
101 Amplifiers with these added feature

- Loudness control giving bass boost at low volume.
- Sensitivity switch — normal or wide band.
- Provision for tape recorder with separate record-pla switch.
- Calibrated dial available for all States showing mai stations in larger type.
- Fully guaranteed.

SPECIFICATIONS COMMON TO BOTH UNITS

● Inbuilt high gain tuner with a frequency coverage of 530 to 1,600 K.C. ● EM84 tuning indicator giving accurate tuning with ease. ● channel tone control stage with separate bass and treble controls. ● Input facilities with switching for pick-up and stereo or mono tape rec for record of play back. ● Chassis is plated and mounted in attractive and durable metal case finished in grey with control panel in black silver with matching knobs. ● Valves used:—4 6GW8, 12AX7 or 12AU7, 6AN7, 6N8, EM84 and 2,210 diodes. Dimensions 15½" x 5¼" x

106 UNIT WITH TUNER

- Output 8 watts per channel (16 watts).
- Incorporating Ferguson type O.P. 412 grain orientated output transformers giving a frequency response of 20 to 30,000 cycles.

$115.50 (£57/15/-)

101 UNIT WITH TUNER

- Output 11 watts per channel (22 watts).
- Incorporating Ferguson type O.P. 387 grain oriented output t formers giving a frequency response of 20 to 30,000 cycles.

$119.50 (£59/15/-)

106 AMPLIFIER WITH GARRARD CHANGER
AND HI-FI SPEAKERS

Type 3000 changer fitted with 9th Sonatone ceramic cartridge and diamond stylus and two Magnavox 8WR or Rola 8CM. 8in Hi-Fi speakers.

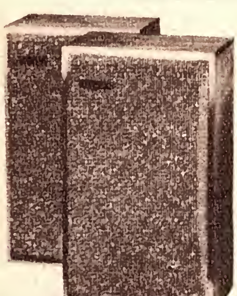
$160.00 (£80)

FREIGHT EXTRA

101 AMPLIFIER WITH GARRARD CHANG
AND HI-FI SPEAKERS

Type AT6 changer fitted with Sonatone 9TA ceramic cartridge diamond stylus and two Rola 12PX 12in speakers or two Philips dual cone Hi-Fi 8in speakers.

$190.00 (£95/-/-)



CABINET DIMENSIONS
18" x 12" x 7"

PLAYMASTER BOOKSHELF LOUD SPEAKER SYSTEM

Complete unit, built, wired and polished in walnut, teak or maple.

$30 (£15.0.0)

Post and packing:
N.S.W. $2.00, Interstate $3.00.

Complete kit of parts less Cabinet but including Speakers, Inductance, Condenser, Resistor, Innabond and Speaker Silk.

$17.50 each Post and packing $1.25 extra.

Available 7½ or 15 ohm impedance.

THE NEW MULLARD BOOKSHELF MINI SPEAKER UNITS

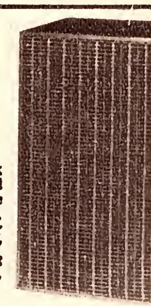
As featured in "Mullard Outlook," April, 1966, issue.

These units designed by Mullard and Magnavox engineers compare favourably with imported B/S Speakers costing more than twice the amount and are ideal where space is limited. Incorporates the Magnavox 6WR 6in Speaker and the new 3TC Mk 11 tweeter frequency response, 50 to 18,000 cycles. Power rating max. 8 watts. Polished in rosewood, teak, maple or walnut.

Available in 7½ or 15 ohm impedance.

$27 (£13/10/-) each

Post and packing: N.S.W. $1.50, Interstate $2.50.



CABINET DIMENSIONS
14in x 8in x 8

NEW SUPER BOOKSHELF SPEAKERS as featured in December '66 "Electronics Australia." Finished in Teak, Walnut or Maple $39.00 each, postage $2.00.

NEW AMPLIFIERS AND TUNERS BASED ON THE PLAYMASTER 106 AND 107

107 AMPLIFIER AND TUNER
$79.50 (£39/15/-)
FREIGHT EXTRA

106 AMPLIFIER AI TUNER
$104.00 (£52)
FREIGHT EXTRA

107 AMPLIFIER

● Output 5 watts per channel (10 watts). Ferguson output transformers with a response of 30 to 20,000 cycles.

● Valves used: 6AN7, 6N8, 2—12AT7, 2—6BQ5, and 6CA4 rectifier.

SPECIFICATIONS COMMON TO BOTH UNITS

- Inbuilt high-gain tuner with a frequency coverage of 530 to 1,600KC.
- Two-channel tone control stage with separate bass and treble controls.
- Switching facilities for pick-up and stereo or mono tape recorder for record or play-back.
- Loudness control giving bass boost at low volume.
- Chassis plated and mounted in attractive metal case finished in grey with control panel in silver and black with matching knobs and switches.
- Dimensions: 13½in x 5¼in x 11in.
- Fully guaranteed.

106 AMPLIFIER

● Output 8 watts channel (16 watts). guson oriented grain put transformers wit response of 20 to 3(cycles.

● EM84 tuning indic

● Valves used 6AN7 12AU7 or 12AX7. 6GW8 and 2 — 0/ rectifiers.

THE ABOVE AMPLIFIERS SUPPLIED WITH THE NEW GARRARD 1,000 CHANGER WITH RONETTE CARTRIDGE AI TWO MAGNAVOX 8WR OR ROLA 8CMX HI-FI SPEAKERS

107—$116.75 (£58/7/6) **FREIGHT EXTRA** **106—$141.25 (£70/12/(**

CLASSIC RADIO

245 PARRAMATTA ROAD, HABERFIELD, N.S.W. PHONE 71-2145

me 26 Sydney suburbs. Under the ton of Max Percy, an experienced strumentalist and conductor, they give excellent account of themselves. So so do the songsters under Russell Belt. fact, the whole presentation rated tter with this reviewer than comparle programs I have heard from major erseas corps.

The track titles: Soldier Rouse Thee, en of Harlech — Torchbearers — ıvonic Dance No. 8 (Dvorak) — ɔrm The Forts — Cleansing For Me Soldiers Of Christ — The Scarlet ·sey — Let The People Say Amen The Trumpeters — Jesus Died Alone.

As noted above, the quality is good, t the recorded level on the disc pears to be somewhat below average. ·rtunately, the surface noise is low d turning up the volume control to mpensate does not cause any compliions. (W.N.W.)

★ ★ ★

ERE YOU THERE? Peter Marshall. Great Sermon series. Mono, Word (Gospel Film Ministry) W-3228-LP.

Interest: Well known preacher.
Delivery: Convincing.
Quality: Quite acceptable.

Rev. Peter Marshall, former chap- ı to the United States Senate, was commended to many people who might not otherwise have known of him, by his wife's book "A Man Called Peter" and by the very successful picture made by 20th. Century-Fox, starring Richard Todd. Although it is quite some time now since I saw the picture, I couldn't help but note how my recollection of it fitted the photograph and the voice of the real person.

On this album are two sermons recorded by Peter Marshall during March, 1944, just before his death. "Were You There?" has an Easter theme. "Compromise In Egypt" takes a novel look at the conflict between Moses and the Pharaoh and is developed by Peter Marshall into a condemnation of compromise in Christian living and principles. Both sermons begin with a highly pictorial and seemingly well rehearsed description of the setting, the presentation gradually changing to a forthright proclamation of the message that Marshall is trying to communicate.

There is probably a limit to the number of recorded sermons one would want in a Gospel collection and a limit to the use which could be made of same but these two, delivered by such a famous and capable preacher must warrant special consideration. (W.N.W.)

ɪnstrumental, Vocal & Humour

STRUMENTAL MUSIC OF THE COURTS OF QUEEN ELIZABETH AND KING JAMES. The New York Pro Musica Instrumental Ensembles. Universal Record Club, stereo U796. Available in mono.

Interest: Sixteenth century music.
Performance: Authentic.
Quality: Excellent.
Stereo: Rather restricted.

The idea of re-creating music of the ıt-renaissance era with authentic truments of the period has been a our of love of the New York Pro ısica for some years, and previous cs in their series of recordings have en reviewed in these columns on eral occasions. This disc is devoted English music of the period embraced the second half of the sixteenth ıtury, at which time English com- ɪers were very much in vogue, and re setting the fashions for the Euro- ın musical world. The program pre- ted here comprises: Five dances ıthony Holborne) — In Nomine a 4 hn Ward) — Lord Willobies Welcome me (William Byrd) — Il Lamento ıomas Lupo) — Fantasia a 5 (Gio- ıi Coperario alias John Cooper) — o Masque Dances (Anonymous) — ıtasia a 3 (Thomas Lupo) — The ·d Salisbury His Pavane (Orlando ɔbons) — Five Dances (Anthony Holne).

Space does not allow any examination the music, but it is worth mentioning efly that it is based on the old church des, the present system of tonality having been established at that iod. This accounts for the rather lesiastical flavour noticeable through- . The main instruments used are the nett, which is a type of folded horn, directly related to the cornet of ay; the shawm, a double-reeded trument, forerunner of the modern be; the sackbut, from which the trombone has directly descended; recorders or various types, from which the clarinet was eventually evolved (although no reed is used in the recorder); viols and rebecs, easily recognisable as the ancestors of the stringed instruments of the modern orchestra; and various other minor instruments no longer surviving in any modern form, e.g., the portable organ and symphony.

For those with any interest at all in music of the past, this record will have great appeal, since the Pro Musica are experts in the handling of the instruments they use, probably far better than the musicians of the period. Apart from this, I hesitate to make recommendations since the sounds made by the instruments may fall strangely on ears accustomed to the modern symphony orchestra. I am afraid it is a case of "if in doubt, find out" before buying. (H.A.T.)

★ ★ ★

ROMANTIC RUSSIA. The London Symphony Orchestra and Chorus, conducted by Georg Solti. Decca (E.M.I.) stereo SXLA6263. Available in mono.

Interest: Russian classics.
Performance: Excellent.
Quality: Demonstration standard.
Stereo: Wide, smooth spread.

In view of the limitations imposed by lack of musical training facilities in the Russia of the last century, the amount of excellent material produced by Russia's few famous composers of the period is remarkable. It is probable that much of the music which has survived would have sunk into relative obscurity if it had not been for the skill of Rimsky-Korsakoff as an orchestrator, since composers like Borodin, although able to compose beautiful melodies, were no great shakes at orchestrating their works. Of the five works on this disc, no less than four were orchestrated by Rimsky-Korsakoff. These are: Prelude

There's an AIWA microphone to solve your recording problem.

AIWA DM.57 DYNAMIC MICROPHONE—Impedance: 60 and 50K. Frequency Response: 100-13,000 cps. Sensitivity: 75 db's. Dimensions: $7\frac{3}{4}$" x $1\frac{3}{4}$". Weight: 14 ozs. **$16.80**

AIWA DM.17 OMNI-DIRECTIONAL DYNAMIC BOOM MICROPHONE—Impedance: 50K or 50Ω. Frequency Response: 70-14,000 cps. Sensitivity: 75 db's. Dimensions: $5\frac{5}{8}$" x $1\frac{5}{8}$". Weight: $10\frac{1}{2}$ ozs. **$16.80**

AIWA DM.51 DYNAMIC MICROPHONE. Impedance: 50Ω or 50KΩ. Frequency Response: 50-15,000 cps. Sensitivity: 55 db's. Dimensions: 10" x $1\frac{3}{8}$". Weight: 29 ozs. **$27.00**

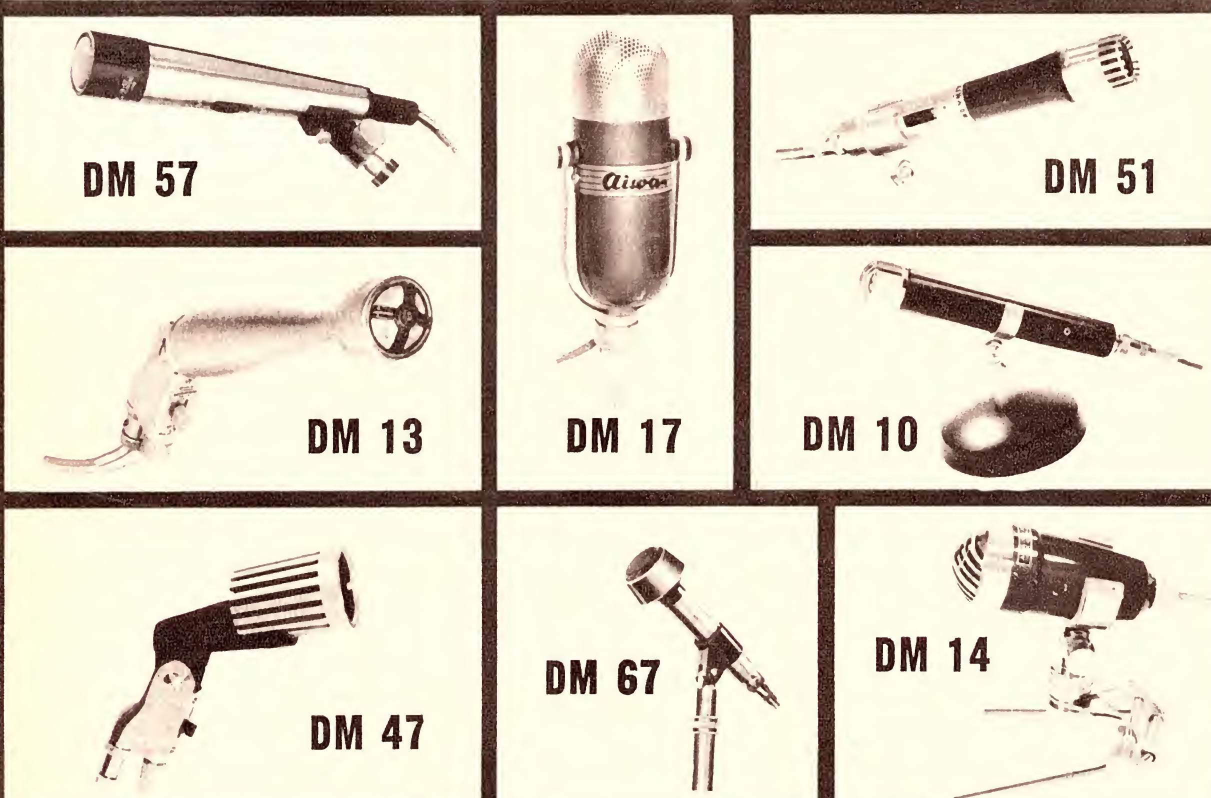
AIWA DYNAMIC NON-DIRECTIONAL MICROPHONE DM.13—Impedance: 50K or 50Ω. Frequency Response: 60 c's-14,000 cps. Sensitivity: 55 db's. Dimensions: Length $10\frac{1}{2}$". Weight: $18\frac{1}{2}$ ozs. **$23.00**

AIWA UNI-DIRECTIONAL DYNAMIC MICROPHONE DM.47—Impedance: 50Ω or 50K. Frequency Response: 40-18,000 cps. Sensitivity: 75 db's. Dimensions: $5\frac{1}{2}$" x $1\frac{13}{16}$". Weight: 18 ozs. with cord. **$36.00**

AIWA DM.10 DYNAMIC DESK MICROPHONE—Impedance: 50KΩ or 50Ω. Frequency Response: 60-13 Kc's. Sensitivity: 75 db's. Dimensions: $7\frac{1}{4}$" x $1\frac{1}{4}$". Weight: 11 ozs. without stand. **$16.80**

AIWA DM.14 DYNAMIC MICROPHONE—Impedance: 50Ω or 50K. Frequency Response: 90 c's-14,000 cps. Sensitivity: 75 db's. Dimensions: $3\frac{3}{8}$" x $1\frac{3}{4}$". Wt. 10 ozs. **$12.50**

AIWA DM.67 CARDIOD DYNAMIC MICROPHONE — Impedance 50Ω or 50 KΩ. Frequency response 100> 12000 CPS with 15 dB. Front to rear separation. Sensitivity: 74 dB. Dimensions: $5\frac{1}{2}$" x 2" max. Weight: 8 ozs. **$30.00**



Distributed by:

GOLDRING ENGINEERING (A'ASIA) PTY. LTD.

N.S.W.: 443 Kent Street, Sydney. 29.1275
VIC.: 368 Little Bourke Street, Melbourne. 67.1197.
QLD.: 235 Edward Street, Brisbane. 2.7010
W.A.: 91 Hay Street, Subiaco, Perth. 8.4988.
S.A.: 77 Wright Street, Adelaide. 51.5117.

GE:P345

m "Khovanshchina" (Moussorgsky)—
ght on Bare Mountain (Moussorgsky)
Overture to "Prince Igor" (Borodin)
Polovtsian Dances (Borodin). The
naining work is Overture to "Russlan
l Ludmilla" by Glinka.

Leaving aside the matter of program
ntent for the moment, I found it im-
sible to fault this disc in any way.
e playing of the London Symphony
chestra under Georg Solti is absolute-
splendid; the addition of the choral
t to the "Polovtsian Dances" adds a
asure of excitement which is often
king in the purely orchestral version
often played; and technically, the
e is first class, with bright, clean
nd and no trace of surface noise. I
feel a touch of disappointment at
t with the lack of enterprise shown
the producer in selecting the pro-
m, since these particular works have
n recorded so often in the past they
in danger of becoming hackneyed.
the final analysis, however, I was
y glad to have the disc, since these
endid performances will certainly
nd comparison with any alternative
sions available. (H.A.T.)

★ ★ ★

IERIACHI SPECTACULAR. The Tokyo Cuban Boys. King Records (Festival) stereo SFL-932,214. Available in mono.

Interest: Brass and Mariachi.
Performance: World class.
Quality: Excellent.
Stereo: Wide spread.

The odd title of this disc is presumably nisprint, for it is surely intended to "Mariachi Spectacular." A glance at tune titles will show why—every one been featured by Herb Alpert: A ste of Honey—Work Song—Hello lly—South of the Border—A Walk the Black Forest—La Virgen de la carena—Spanish Flea—Lady of Spain Magic Trumpet—Adios—What Now Love—Taboo.

must confess that the appearance of disc on my desk evoked a mental an. I had just about had my fill of uana Brass imitators—and now this e, from Japan, of all places. But, de-te these reservations, I thoroughly oyed the playing of the Tokyo Cuban ys in their presentation of these niliar numbers. They produce a bright l lively sound, and their instrumental rk and ensemble are in world class. Most earlier reviews of King Records cs have commented on the technical cellence, and this disc is no exception. ose with a liking for Mariachi style isic should make a point of asking a demonstration when visiting their ord supplier. I guarantee they will e what they hear. (H.A.T.)

★ ★ ★

AMOUS OPERA AND CONCERT MARCHES. The Vienna State Symphony Orchestra conducted by Hans Swarowsky. Synchro stereo, Concert Hall SMS 2482.

Interest: As per title.
Performance: Excellent.
Quality: Clean.

At first glance,this might appear to along the lines of "favourite excerpts om the classics," but really it isn't. hile the items will be well known to ncert goers, the music itself is likely be less familiar to potential "excerpt" yers than the more usual sort of selec-n. Perhaps this is something of a mmendation, particularly as the album features a definite theme — Famous Marches: March From Fidelio (Beethoven) — March Of The Priests From The Magic Flute (Mozart) — Turkish March From The Ruins Of Athens (Beethoven) — Three Marches For Orchestra K.408 (Mozart) — War March of the Priests from Athalie (Mendelssohn) — Entry March From The Gypsy Baron (Johann Strauss II) — Coronation March From The Prophet (Meyerbeer) — Hungarian March From The Damnation Of Faust (Berlioz) — Grand March From Tannhauser (Wagner) — Funeral Music From Gotterdammerung (Wagner).

Side 1 commences in rather modest fashion, with not too much spread, lots of bass from the middle and a suspicion that the compatible stereo-mono recording may have forced a not very inspiring compromise. But early reservations are dispelled as track follows track and the dynamics and spread of the Hungarian March leave nothing to be desired. The album concludes with the eerie but powerful Gotterdammerung.

Yes, well worth a hearing. (W.N.W.)

★ ★ ★

SPANISH STRINGS. Enoch Light and the Light Brigade. Stereo, Festival Project 3, SPJL-932171. Also available in mono PJL-32171.

Interest: Sound spectacular.
Performance: Precise.
Quality: Some reservations.
Stereo: Exceptional separation.

It was some years ago that Enoch Light first featured the use of 35mm magnetic film masters—and released some top-quality sound to emphasise his point. He seems now to be saying the same thing all over again, but with a new tag: "Project 3." Again—or still—the mastering would seem to be very good, with expert work at the panels, wide dynamic range, extreme separation where sought and virtually no background noise.

My impression, however, is that Project 3 engineers have been less than discrete in transferring their efforts to disc. The groove looks and sounds to be very heavily modulated and, while some of the sound is very hard and very clean, there are passages which had a definite "edge" with the good-average quality magnetic cartridge which I was using for the review.

Musically, it is a quite typical Enoch Light effort, with any amount of talent from arrangement to execution but all aimed at maximum sonic impact. Some will find it exhilarating, some rather noisy. The titles: April In Portugal—Without You—Come On, Don't Be Timido—What A Difference A Day Made—Perhaps, Perhaps, Perhaps—Maria My Own—How Insensitive—Someone To Light Up My Life—Lisbon Antigua—I Love, I Live, I Love—Blue Tango—La Mentira.

Best you hear it for yourself. (W.N.W.)

★ ★ ★

THE GREAT ARRIVAL. Sergio Mendes. Atlantic (Festival) stereo SAL-932,200. Available in mono.

Interest: Latin American jazz.
Performance: Cool, elegant.
Quality: Very good.
Stereo: Normal spread.

The main attraction of this disc is the tasteful and elegant playing of young Brazilian pianist Sergio Mendes. However, to this must be added the excellent arrangements by three well-known musical personalities in U.S.A.—Clare Fisher, Bob Florence and Dick Hazard. Finally, there are the enjoyable tunes included in this selection, many of them by Brazilian composers: The Great Arrival—Monday, Monday—Carnaval—Cancao do Amanhecer — Here's That Rainy Day—Boranda—Nana—Bonita—Morning—Don't Go Breaking My Heart—Tristeza de Amar—Girl Talk.

An anonymous group of competent musicians provides a solid framework around which the talented fingers of Senhor Mendes weave a pattern of cool Latin American jazz. This is Senhor Mendes' first disc, and I don't doubt that there will be many more to come. (H.A.T.)

★ ★ ★

TIJUANA TAXI AND OTHERS. The Living Marimbas. RCA Camden stereo CAS-961. Available in mono.

Interest: Latin American.
Performance: Stylish and original.
Quality: Very good.
Stereo: Well spread.

What a relief it is to get a record of Latin American music which does not use trumpets and Mariachi band. This one seems to be making a determined attempt to get away from the now

NEW SYDNEY ENCEL STEREO CENTRE A MUSIC LOVER'S MECCA!

Although only just over one year old, the Sydney branch of Encel Electronics is a very healthy infant. Situated on the Ground Floor of the 2SM Building at 257 Clarence Street, the store incorporates a complete Service Centre. Harbor City music lovers are always welcome . . .

PIONEER SMQ-300B STEREO AMPLIFIERS

With AM/AM/FW/SW tuners and a frequency response of 20-20,000 Hz. the SMQ-300B offers 20 watts peak power in each channel. Mode blend, scratch and rumble controls are additional features. Retail $270.20 Brand new in sealed cartons. Encel price **$175**

SHORT OF SPACE? BUY A WHARFEDALE "LINTON"!

Only 19" x 10" x 10" but a proven performer as a compact speaker system. Ask for an EMQ or a trade-in valuation.

COMPARE THE QUALITY OF THE NEW "SOUND" SAT-200X STEREO TUNER/AMPLIFIER

Here is an effective combination stereo tuner/amplifier with plenty of power for realistic stereophonic listening. Frequency response from 20-20,000 Hz plus or minus 1 dB., output is 12 watts R.M.S. per channel (36 watts total music power). PP 6GW8's are used in both channels. The stereo AM tuner pulls in distant stations . . . and an FM stereo Multiplex tuner may be added. Switches are provided for scratch suppression, loudness control, rumble filter and tape monitor. Stereo 'phones plug into the front panel. All normal mode and tone controls are standard. Beautifully finished, this versatile amplifier has been designed for use with magnetic or ceramic/crystal pick-ups. Ask for detailed specifications **$148**

SEE YOUR NEAREST ENCEL STEREO CENTRE FOR REDUCED PRICES ON THE FAMOUS LEAK SANDWICH SPEAKER SYSTEM!

The new reduced price applies at all Encel Stereo Centres . . . and stocks are also available of the new Leak Mini Sandwich. Both systems provide excellent audio, the smaller unit differing only in the lowest octave. Write for an EMQ or a trade-in valuation.

SPECIAL ENCEL TAPE/DISC STEREO SYSTEM

Here's value for the discriminating purchaser. Comprising a Tandberg Series 12 stereo tape recorder (now for immediate delivery at Encel's), Connoisseur Classic turntable on a teak base, the precision Nikka tone arm with a Connoisseur ceramic stereo cartridge (diamond stylus) and two five-speaker Sonics Model AS-61 hand finished enclosures . . . all items are BRAND NEW and FULLY GUARANTEED . . . price is only (inc. sales tax) **$457**

NOW ADDITION OF STEREO 'PHONES COSTS LESS THAN EVER BEFORE!

Here are two popular stereo headsets . . . both are fitted with foam rubber earpads to reduce external noise and promote listener comfort. The Sonics Model HS-303 has a frequency response of 30-15,000 Hz. and costs only $11.50. The Elega Model DR-62C features a separate volume control for each earpiece and is attractively priced at $13. Both are fitted with standard PMG type jacks **$11.50**

BRENELL STEREO RECORDER FOR $382

Model STB 2/5/2 stereo tape recorders usually cost $764 complete with amplifiers. This special is in an original carton . . . quickly **$382**

CELESTION "STUDIO SERIES" LOUDSPEAKERS

The "Celestion" Deluxe Model CX2012 is rated at 20 watts RMS and frequency response is **conservatively quoted** as 30-18,000 Hz. A special "Brilliance" control operates in the tweeter circuit — the electrical cross-over is at 4 kHz. See reviews in the "Gramophone" p.511, April, '65, and "Hi-Fi News" p.75, June, '65. ENCEL PRICE: CX2012 ...... **$59**

Celestion 12" co-axial loudspeakers have been received most enthusiastically by audio enthusiasts and music lovers in Australia. Clarity, transient performance and attack are particularly satisfying. Both models feature co-axial tweeters with electrical cross-overs at 4 kHz. The Standard Model CX1512 has a frequency response **conservatively quoted** at 30-15,000 Hz and it rated at 15 watts RMS. Encel Price CX1512 ...... **$39.50**

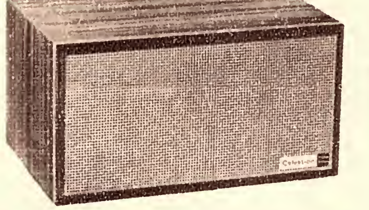
SUPERLATIVE IMPORTED WOOFERS—BOTH 15" and 18" AVAILABLE NOW!

Rugged and powerful Celestion woofers are particularly suited to public address, guitar and electronic organ applications — and for the bass registers in multiple speaker systems. In Europe both speakers are very popular . . . often they are supplied as standard equipment with expensive imported electronic organs and guitar amplifiers.

G15C. A 35 watts RMS 15" speaker, this new Celestion unit has been designed for use with organs, guitars and public address systems. Feroba II ceramic magnet, total flux 180,000 maxwells. This powerful reproducer is Encel priced at only **$68.50**

OUTSTANDING NEW 18" BASS SPEAKER WITH 20 Hz. BASIC RESONANCE

Use of a new type rubber surround reduces the resonance of the new Celestion G18C to 20 Hz. Total flux is 285,000 maxwells, power handling capacity is 100 watts R.M.S. This massive woofer is ideal for the sophisticated audiophile who is seeking the ultimate in bass reproduction at relatively modest price Also suitable for electronic organs, electric guitars, etc. Write for specifications **$98.50**



IF THERE'S A BATTLE OF THE COMPACTS . . . THE CELESTION "DITTON 10" IS WELL TO THE FORE

Many music lovers require compact speaker systems . . . and tape recording enthusiasts find the addition of external speaker systems makes an astounding difference to performance. Although only 12" x 6½" x 8¼" the "Ditton 10" incorporates two units, the bass reproducer being a specially designed "long throw" model which extends LF response. Power handling capacity is 10 watts R.M.S. Both 3 and 15 ohm impedances are available . . . the 3 ohm model is ideal for use with solid state amplifiers and tape recorders. See the reviews in "Hi-Fi News", p.433, Oct., '65, and the "Gramophone", p.41, June, '65. Write for copies of these enthusiastic reports. The "Ditton 10" is beautifully finished in teak or walnut veneers. These compact systems are used by one of Australia's leading universities to reinforce sound in the auditorium ... **$59**

TAPE RECORDERS

Although our range of recorders is wide, Encel prices have assured a speedy turnover . . . ask for EMQ's or trade-in valuations. Save more at Encel Electronics!

FISHER EQUIPMENT SLASHED

The Model X 101 stereo amplifier normally sells for $296. This brand new unit is Encel priced at **$19**

Model XP5 Speaker Systems . . . Retail $98 . . . now only **$6**

HAMMOND M100 CONDENSER MICROPHONES

Designed for use in recording studios as w as by the recording enthusiast, the supe M100 is available in both mono and ster versions. Frequency response is 30Hz. to kHz. plus or minus 1 dB. See the revie in the "Tape Recorder", Feb., 1966. Prices: Stereo $118, Mono $74 (both with power supply) **$7**

SPECIAL TONE ARM OFFER!

Now we are able to supply new Ortof SMG-212 tone arms complete with ne Connoisseur ceramic diamond cartridg (diamond stylus) for only $33.50. Ortof SPU-GT-E cartridges are available with t Ortofon SMG-212 arm for only $59.50. For the SPU-GT-E alone? Encel price is **$36.5**

MICRO MAGNETIC CARTRIDGE OFFER UNEQUALLED VALUE

For only $19.50 you can now purchase a t quality magnetic cartridge with diamond styl . . the Micro VF-3000. Response of th new model is 20-25,000 Hz. The Mic M 2000/5 is Encel priced at only $16 50, 's similar electronic design and has a respon of 20-22,000 Hz. Both feature a 15° vertic tracking angle. Performance is comparab with cartridges twice the Encel price . . call in to your nearest Encel Stereo Cent and hear just how effective are the modest priced Micro moving magnet cartridges. Inc. sales tax: VF-3000 ...... **$19.5**

M 2000/5 ...... **$16.5**

LOW PRICED SOLID STATE STEREO AMPLIFIER

With 6 watts R.M.S. per channel, the Soun Model SAQ-202B must be regarded as excep tional value at this price. Separate bass an treble controls, input sens. is 100 mV. f pick-up, tuner and auxiliary. In attractiv metal case. Frequency response is 20-20,000 Hz. plus or minus 3 dB. 12 transistors **$4**

NOW . . . A HIGH PERFORMANCE STEREO SYSTEM FOR SMALL LOUNGE ROOMS AND MODEST BUDGETS . . . THE ENCEL "COMPAX"!

Many music lovers have little space to spar —and require a small stereo system. The ne Encel "Compax" consists of the Soun SAQ-202B solid state stereo amplifier with a output of 6 watts R.M.S. or 12 watt I.H.F.M. in each channel, a Connoisseu Classic turntable, the precision Nikka ton arm, a Micro ceramic stereo cartridge wit diamond stylus, a teak base for the equip ment and two hand finished multiple-speake bookshelf enclosures. Stereo headphones ma be added for only **$11** more. **Encel price** including sales tax is only **$156**

A Mk. II "Compax" has just been intro duced. The "Sound SAQ-202B" amplifie and speaker systems are the same; with thi model the turntable supplied is the wel known Labcraft 643, the tone arm has lifting/lowering device, the cartridge is high quality ceramic unit with a diamon stylus and the equipment is housed in a attractive base with a perspex dust-proof cover. This Mk. II "Compax" costs only **$145**

NEW POCKET SIZE AUSTRIAN DICTATING MACHINE

The new Stuzzi "Memo-Cord" is a compac and versatile completely self-contained dictat ing machine which may be used anywher . . . in the office, at home or in the car This four track unit incorporates a built-i microphone/speaker . . . accessories availabl — lapel microphone. Recording/playing tim is 1 hour, size is 4½" x 3¼" x 1¼", weigh is 11 ozs. with batteries. Fully transistorised. Fast push-button operation. Encel priced at only **$39.90**

Encel ELECTRONICS PTY. LTD.

Head Office: 431 Bridge Rd., Richmond, Vic. Tel. 42 3762
City Branch: 18 Bourke St., Melbourne. Tel. 32 2672
Sydney Store: 257 Clarence St., Sydney. Tel. 29 4563, 29 456
Ground Floor, 2SM Building

Australia's Greatest Hi-Fi Centre

★ Wholesalers,
★ Trade-ins accepted

ıer ·tired formula mentioned above, l bases its melodies on the marimba. ɔse who are not familiar with this rument may care to know that it is y similar in sound to the vibraphone, is rather more mellow, with a deeper e. The result is some sweet-sounding sions of the 10 numbers included in selection (playing time just under 27 ıutes).

'une titles are: Tijuana Taxi—Pers, Perhaps, Perhaps—Spanish Eyes— Besos—Spanish Harlem—Mexico do—Made For Each Other—Maria ıita — Tijuana Rose — Mu-Cha-Cha. :se have been skilfully arranged and tastefully conducted by Leo Addeo, ɔse own composition "Tijuana Rose" included in this selection—the first e on disc, I believe. The instrumen- work of the band is of the highest er, so all in all, at the low Camden :e, this disc represents excellent value money. (H.A.T.)

* * *

MOUS OPERA THEMES. Ray Martin and his Concert Orchestra. CBS stereo SBP 23353. Available in mono.

Interest: Opera evergreens.
Performance: Satisfactory.
Quality: Very good.
Stereo: Normal.

:very one of the tunes included in selection has that quality of greats which ensures a place in the affec- ı of the music-lover. It is seldom that : can listen through a record of this d and enjoy every track—there is usu- ' a mixture of good and indifferent, some reason. But whoever made the :ction here knew his stuff, and I feel e these tunes will have almost uni- sal appeal. Titles are: All Are Caught Love's Fond Snares from "Bartered de" (Smetana) — Oh! My Beloved, ddy from "Gianni Schichi" (Puccini)— banera from "Carmen" (Bizet)—Up- rd the Flames from "Il Trovatore" :rdi)—Lovely Flowers, I Pray from ıust" (Gounod)—Lionel's Song from artha" (Flotow)—Drinking Song from ı Traviata" (Verdi)—Oh! Star of Eve m "Tannhauser" (Wagner)—Barcarolle m "Tales of Hoffmann" (Offenbach)— ermezzo from "Cavalleria Rusti- ıa" (Mascagni)—When the Stars were ghtly Shining from "Tosca" (Puccini) ;oftly Awakes My Heart from "Sam- ı and Delilah" (Saint-Saens).

[he orchestra plays these in a very isfactory manner. But I did feel that arrangements showed a lack of finesse 'or example, the marking of each bar a cymbal in some numbers is ıecessary and distracting. Barring this all quibble, I can recommend this ord to those who like the lighter and ›re tuneful numbers from opera. .A.T.)

* * *

:EDS AND PERCUSSION. The Command All Stars. Calendar (Festival) stereo SR66-9,168.

Interest: Enoch Light reissue.
Performance: Faultless.
Quality: Excellent.
Stereo: Good, but gimmicky.

The famous series of Command discs a few years ago, master-minded by ıoch Light, were a highlight in popular ısic recording, combining as they did st-class musicianship, excellent arrange- :nts and faultless recording. Those ıo have not yet obtained these for eir record collection now have an portunity to buy them at a bargain price, since Festival have now begun to reissue them on their Calendar label. This disc is typical of the clever orchestral combinations used in the series—it uses clarinets, saxes, bassoons and percussion. At least, that is what I make of the combination after listening—there is no sleeve note to help. Whatever it is, it is first-class playing, and thoroughly enjoyable.

There are 12 tracks, giving full value for money, instead of the 10 which are now becoming common, particularly in low-priced discs. Tune titles are: She's Funny That Way—Serenata—I Guess I'll Have to Change My Plan—Pavanne—As Time Goes By—I Want to be Happy—Bewitched — Badinage — S'posin' — Saxophobia—Thou Swell—Stompin' at the Savoy. The sound quality is well up to par, and it is only the gimmicky stereo which dates the recording—nowadays it is not regarded as clever to switch over from one channel to the other at the beginning of every track. (H.A.T.)

* * *

THE DISTINCTIVE PIANO STYLE OF FLOYD CRAMER. Floyd Cramer with orchestra. RCA Camden stereo CAS-2104.

Interest: Jazz pianist.
Performance: Routine.
Quality: Very good.
Stereo: Good spread.

There is nothing much to get excited about in this run-of-the-mill recording of popular numbers. Floyd Cramer and the supporting band play competently enough, but without much spirit—in fact, without any of those special qualities of artistry or style which lifts a recording above average level. The appeal for potential buyers will therefore be more in the titles than the performers, and if you want these particular tunes, this disc has the advantage of being available at the Camden price—just under $3.

Track titles: Tuxedo Junction—Cryin' —The Three Bells—All Night Long—Naomi—Don't Get Around Much Anymore—Tomorrow's Gone—Goin' Home —Kisses and Tears—Hong Kong. Technically, the disc is of a good standard. (H.A.T.)

* * *

RHYTHMS OF SPAIN. Sabicas with various artistes. Calendar (Festival) stereo SR66-9,151. Available in mono.

Interest: Flamenco.
Performance: First class.
Quality: Very good.
Stereo: Effective spread.

This recording of Sabicas playing what may be called modern as well as traditional flamenco is particularly good value, since it is an excellent recording, yet available on the low-price Calendar label. In addition to the great Sabicas himself, acknowledged as one of the leading exponents of flamenco, other flamenco artistes of high calibre participate in this program. Most of the emphasis is on the guitar playing and singing, but there is a very good demonstration of taconeo (heel tapping) in a soleares, by Dolores Vargas. In guitar duets, Juan de la Mata provides excellent support on the second guitar. There is no male cantor, but Antonia Andalucia sings in a pleasant soprano in the tracks which I have suggested could be called "modern flamenco," since it represents a departure from the traditional style.

The program consists of: Viva Mexico (Bulerias)—Fantasia Militar (Sitio de Saragosa)—Rumores de Granada (Granadinas)—Gardenia (Bulerias)—Aires de la Alhambra (Zambra)—Delalosno and Huelva (Fandangos) — Taconeo for Soleares—Son Como las Flores—Azahar Trianero (Sevillanas) — Aromas de Cadiz (Alegrias). This varied program makes very entertaining listening. (H.A.T.)

* * *

TYPICALLY IRISH. Brendan O'Dowda. Columbia (E.M.I.) stereo, SCXO 6078. Available in mono.

Interest: Irish ballads.
Performance: "Typically Irish."
Quality: Very good.
Stereo: Normal spread.

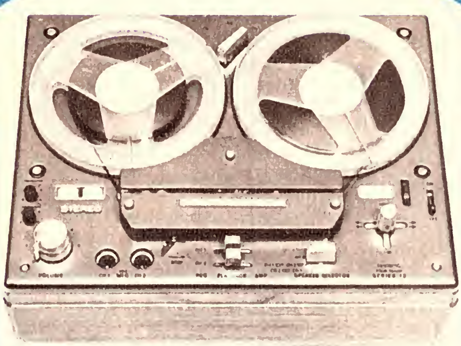
Brendan O'Dowda has been laying claim to the mantle of the late John McCormack with his singing. Now he seems to be making a bid to step into the shoes of Percy French for, of the 16 songs presented here, 11 are of his own composition. These 11 tracks are entitled: "Bedad," Say I—Old Bones—The Pig — Dan — Paddy's Britches — Molly Brannigan—Coortin' in the Kitchen—The Devil and the Woman—The Mac's and the O's—Flannagan's Ball—Typically Irish. These all sound to be well in line with the humorous Irish ballad, in which the Irish poke fun at themselves (for their own amusement, let me add, not for the enjoyment of "furriners"). It remains to be seen whether they will take their place in the repertoire.

The five remaining tracks are: Mick McGilligan's Ball—Father O'Flynn—When I Marry Molly Malone—The Charladies' Ball—The Bonny Wee Mare. All except the third item in this list should be known to those with a liking

Tandberg

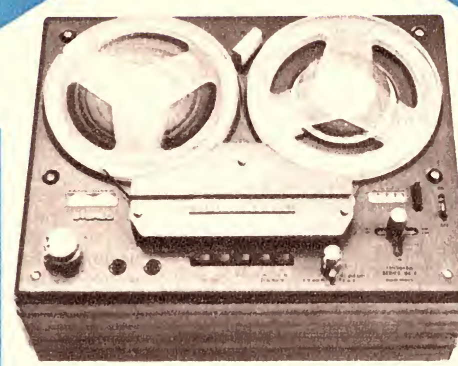
The popular Tandberg "Series 12" | and the new Tandberg Model 6X!

The name Tandberg is synonymous with precision engineering, completely natural sound reproduction and advanced tape recording technology. The "Series 12" has already established an enviable reputation as a completely self-contained stereo system; the new Model 6X Stereo Tape Recorder has been developed with the perfectionist in mind. Nothing has been spared to make the 6X the most effective, efficient and versatile tape recorder available in the world today. Both models proudly carry the Tandberg name.



The proven Tandberg "Series 12" Stereo System

Completely solid state, the "Series 12" incorporates twin ten-watt R.M.S. stereo amplifiers, two built-in wide-range speakers, sensitivity for radio tuners and ceramic/crystal cartridges, concentric volume controls and twin electronic beam indicators for positive control of recording level. At 7½ i.p.s., frequency response is 40-20,000 Hz. Signal to noise is 55 dB. This fine recorder is the most advanced self-contained stereo recorder yet released by Tandberg and may be used with confidence as the heart of a complete high-fidelity stereo system.



The new Tandberg 6X Stereo Tape Recorder

This versatile professional-quality stereo tape deck features a new bias head for guaranteed frequency response and unbeatable signal-to-noise characteristics. At 7½ i.p.s. the signal-to-noise figure is an astounding 62 dB.! Frequency response is 20-25,000 Hz. at 7½ i.p.s., a centre channel amplifier permits simultaneous playback of two tracks to mono 'phones. Monitoring is possible both "on" and "off" the tape as well as "sound on sound". Ask for complete specifications at your favourite audio store.

Australian National Distributors:

Simon Gray Pty. Ltd.

Head Office: 28 Elizabeth Street, Melbourne, Vic. Tel. 63 8101*

Sydney Office: 22 Ridge Street, North Sydney, N.S.W. Tel. 92 3890

INTERSTATE REPRESENTATIVES:

S.A.: Eilco Sales Pty. Ltd., 7-9 Osmond Terrace, Norwood, S.A. Tel. 63 4844

Q'land: Sydney G. Hughes, 154-158 Arthur St., New Farm, Brisbane. Tel. 58 1014

W.A.: Athol M. Hill, 613-615 Wellington Street, Perth. Tel. 21 7861

Tas.: K. W. McCulloch Pty. Ltd., 109 York Street, Launceston. Tel. 2 5322

A.C.T.: Australian Physical Laboratories, P.O. Box 225, Canberra City. Tel. 4 3010 (Mr. J. E. Howe)

N.T.: Pfitzner's Music House, Smith Street, Darwin. Tel. 3801 [rish songs. The other, "When I y Molly Malone" is the work of y O'Donovan, brother of the better-'n Frank O'Donovan, who wrote classic "Charladies' Ball," also red in this selection.

I have remarked in previous re-; of discs by Brendan O'Dowda, I ot place him in the same class as McCormack, but he has a pleasant and an engaging manner—which pose is all that is required for this of performance. (H.A.T.)

★ ★ ★

DEMY AWARD SONGS 1934-45. Frank Chacksfield and his orchestra. Stereo, World Record Club ST-4223. Also available in mono.

Interest: A dozen of the best.
Performance: Smooth, melodic.
Quality: Above reproach.
Stereo: Normal.

would be a very poor orchestra could miss out with this group of r-winning songs from the movies—Frank Chacksfield's is far from being or orchestra. On the contrary, I t that I've ever heard the songs nted to better advantage: 1934, The inental—1935 Lullaby Of Broad-—1936, The Way You Look Tonight 37, Sweet Leilani—1938, Thanks The Memory—1939, Over The Rain-—1940, When You Wish Upon A —1941, The Last Time I Saw Paris 42, White Christmas—1943, You'll r Know—1944, Swinging On A —1945, It Might As Well Be Spring. ot only is the music tuneful and played, but the quality is abso-y first rate, unspoiled by any trace urface noise. In short, one I can tily recommend. (W.N.W.)

★ ★ ★

MUSIC OF WALT DISNEY—From Snow White to Mary Poppins, themes taken from the sound tracks. Walt Disney memorial LP, proceeds to be shared between the California Institute of the Arts and the Arts Council of Australia. Buena Vista 12-inch mono, BVS-2000.

Interest: Disney favourites.
Performance: Original sound tracks.
Recording: Variable, but O.K.

alt Disney must surely have been of the few real showmen to have ared to date in the movies' short ry. He was certainly the only one nd real success with the animated Despite what one might think of later "ultra-realistic" animated pro-ions, his lavish sentimentality and "rehash" TV programs, there can o doubt that his films brought great yment to literally millions of people ghout the civilised world. And very y they will continue to do so for y years to come . . .

is being the case, there will probab-e considerable interest in this Dis-memorial disc, which brings back ories of many of his more popular luctions. There's "Hi Ho" from Snow te, "Little April Shower" from Bam-'Zip-A-Dee-Doo-Dah" from Song of South, "The Work Song" of the se chorus in Cinderella, and many rs. And, of course, "When You Wish n a Star" from Pinocchio, which almost become the Disney trade-k.

he recording is a little variable, as might expect, but all things con-red it's quite O.K. And one could lly have performances more authen-So if you would like something with which to remember Disney and his many creations, this would be a good choice. (J.R.)

★ ★ ★

FILM ON FILM—Great Movie Themes, played by Enoch Light and The Light Brigade. Master recorded on 35mm magnetic film. Festival "Project 3" 12-inch stereo, SPJL-932,208. (Also in mono, on PJL-32,208.)

Interest: Recent movie themes, in "Total Sound."
Performance: Sparkling.
Recording: Excellent.
Stereo: Wide, smooth.

This latest recording of movie themes by Enoch Light and the Light Brigade is recorded in the "Total Sound" of Project 3, which would appear to be the successor to the Command concept. Like the earlier enterprise it involves recording the master on 35mm magnetic film, and there is no doubt that this can result in an extremely high standard of recording.

As one might expect from this, the present disc is technically excellent. Bass is smooth, treble light and transparent, and the stereo smoothly spread. But whether the music will appeal or not is probably a different matter; it will depend greatly upon the extent to which one likes one's music "Lightened." Personally, I am beginning to find the Lightening process a little like the Mantovani touch, in that every tune seems to come out much the same. Still, it's to a large extent a matter of taste.

The themes are from: The Sand Pebbles—Born Free—The Alphabet Murders—Who's Afraid of Virginia Woolf?—Alfie—Big Hand for a Little Lady—Hawaii—Is Paris Burning?—The Blue Max—Khartoum—Lady L—How To Steal a Million. (J.R.)

★ ★ ★

BIRMINGHAM JAIL. Slim Whitman. Camden (RCA) stereo CAS-954. Available on mono.

Interest: Country and western singer.
Performance: Pleasing, smooth delivery.
Quality: Good.
Stereo: Reprocessed.

From the seemingly inexhaustible store of country and western material held in its archives, RCA have now released these tracks by popular entertainer Slim Whitman on its economy Camden label. Slim Whitman had a rapid rise to fame in the immediate postwar years, and was for a time regarded as one of the outstanding performers in the country and western field. Little is heard of him nowadays, and he may well still be performing, but the sleeve note does not give any information on this point. From these tracks, it is easy to see why he was a success—he has an engaging personality, and his pleasant voice exhibits none of the straining after high notes which is a common failing of many singers of this type.

With these assets, he delivers the following popular numbers very smoothly: Birmingham Jail—Wabash Waltz—Paint a Rose on the Garden Wall—I'll Do As Much for You Some Day—Let's Go to Church—I'm Casting My Lasso Towards the Sky—There's a Rainbow in Every Teardrop—Tears Can Never Drown the Flame—I'm Crying For You —I'll Never Pass This Way Again.

At the low Camden price, this disc is worth investigating by country and western fans. (H.A.T)

Graeme Bell Says . . .

THE SEVEN AGES OF ACKER: Mr Acker Bilk and his Paramount Jazz Band. Columbia, mono 330EX9178.

Interest: British Trad Jazz.
Performance: Very spirited.
Quality: Not very good.

Recorded in 1959 by one of the leading groups to emerge during the great British trad jazz boom, this album, previously issued on the Columbia label, has now been reissued by E.M.I. in the economy price Encore Series. The Bilk band is never dull—always exciting, and this album is no exception, although, technically, the records made in the 60s show a marked improvement.

Two of Acker's hits are included, namely his arrangement of Ketelby's "In a Persian Market" and one of Mr Bilk's many successful compositions, "Summer Set." There is a very virile rendition of "Tiger Rag," and John Mortimer roars out on his version of Kid Ory's trombone feature—' Creole Trombone." The Bilk ban always been partial to old march and this time we have "Berliner March" from the Gay Hussar and Comrades March."

Acker's soaring and always clarinet is the strong part of this and, in addition to two of his inim vocals, there is one by drummer McKay on "Let the Light Fror Lighthouse Shine on Me." Those heard the band in Australia will forget being amazed at the latter's ing negroid vocal style. This re looks forward to hearing some of A recent recordings as, according to reports, the style of the band has completely changed.

★ ★ ★

COMING ON STRONG—Brenda Festival, stereo SDL-932,166. on mono.

Interest: Popular vocal.
Performance: Robust.
Quality: Good.
Stereo: Normal spread.

Brenda Lee has been going for a now, and listening to this album struck with her versatility. "Upright "You've Got Your Troubles" are belting rock treatment, "Comin Strong" and the lilting "Summer are pop arrangements, while "Call and "What Now My Love" are to lively bosa-nova rhythms. The

Three recordings by Fats Waller

1. **FRACTIOUS FINGERING—FATS WALLER. RCA Vintage Seric mono LPV-537.**
2. **HONEY ON THE KEYS—FATS WALLER AND HIS RHYTHM RCA Gold Standard Series, 45E.P. 20394.**
3. **FATS WALLER ORIGINALS. Universal Record Club, mono U-82:**

Thomas Waller was born in New York, 1904 and died in Kansas Cit 1943. He composed dozens of numbers, many still famous, such as "Ain Misbehavin'" and "Honeysuckle Rose"; wrote complete musical revu such as "Keep Shufflin'" and "Hot Chocolates" which were smash hi on Broadway; appeared in many films; played Bach on the Notre Dam Cathedral organ in Paris; and made over 500 records for RCA wit whom he was under contract until his death.

The first album under review is as good a collection of 16 tracks a you would get from this great pianist-entertainer and, I might add, muc better recorded than many a disc made today. Three of the tracks ar piano solos made in 1929, including a previously unissued take c "Gladyse" and that most majestic version of "Sweet Savannah Sue"—bot of them Waller compositions. The other 13 numbers were recorded i 1936 with the members of the Fats Waller Rhythm—Herman Autrey—trumpet, Gene Sedric—clarinet and tenor, Al Casey—guitar, Charl Turner—bass, and Slick Jones—drums—all of whom subsequently becam famous.

Tracks include "Nero," "The Curse of An Aching Heart," "Swingi The Jingle Bells" (a riot) and "Who's Afraid of Love." The whole albur is just bubbling over with humour and happiness in contrast with muc of today's introspective music and, with its 16 tracks, makes for exceller value. This reissue is produced by Mike Lipskin and remastered by Do Miller. The quality is right up to the excellent standard maintained b RCA's Vintage Series.

The second recording is an E.P. comprising "Honey Hush," "Hone suckle Rose," "Whose Honey Are You?", and "There's Honey On Th Moon Tonight,' which are around the same vintage as the L.P., an once again excellently remastered. The third record, however, suffers b comparison, although Side One gives us a chance to hear Waller's master of the Hammond organ. On Side Two he is at the piano, and all of th 12 tracks include a vocal except the waltz from Gounod's "Faust." Som of the other titles are "Loch Lomond," "Oh Dem Golden Slippers,' "Hallelujah I'm A Bum," "She'll Be Comin' Round The Mountain," an "Swing Low, Sweet Chariot." Not very exciting material to work or and Fats sounds rather lonely all there by himself in the studio.

country and western flavour
newhere, and in "You Don't Have To
/ You Love Me" she sometimes
inds like a female Johnny Ray. The
) numbers which impressed me most
"Somewhere" and "Kiss Away,"
ere this singer is more thoughtful and
es out, particularly in the former, in
e cabaret style. Decca Studios have
vided her with excellent studio
hestral backing.

★ ★ ★

VALLARO PLAYS ELLINGTON: Carmen Cavallaro, The Poet of the Piano. Festival, stereo SDL-932,109. Also available on mono.

Interest: Melodic piano solos.
Performance: Excellent.
Quality: Crystal clear.
Stereo: Unnecessary.

Iow sick and tired one can become of grouping together of tunes by a well-wn composer to be used as a vehicle some jazz musician to de-compose. en the only look-in the composer is on the cover, where his name ›s to sell the disc. None of this lies to the album under review, where men Cavallaro sits down at a mag-ent piano and extracts all the beauty dynamics from 12 well-known El-ton tunes. With his pianistic under-ding and sensitive technique, Caval-has delved deeply and intelligently the great compositions of another iist, resulting in a sort of collabor-n.

hose of us who, years ago, used to upon Carmen Cavallaro as a sort vatery Liberace received a very great k when listening to this L.P. Here master of the keyboard—who doesn't ess to be a jazzer—playing with t depth of expression tunes such as ood Indigo," "Satin Doll." "Solitude," et A Song Go Out Of My Heart," Nothing Till You Hear From Me," "Sophisticated Lady."

★ ★ ★

THE MOOD: The Mariachi Brass, featuring Chet Baker. Festival, stereo SFL-932,209. Also on mono.

Interest: For Go-Go Dancing.
Performance: Competent.
Quality: Very Good.
Stereo: Very Effective.

ot so long ago we reviewed this p with its album called "A Taste of iila," which consisted mainly of ican melodies. This latest album, The Mood," consists of 12 of the popular numbers made famous by Glen Miller Orchestra, including rise Serenade," "Chattanooga Choo)," "Little Brown Jug" and "String earls." Practically all of the tunes, ding "In The Mood," "Tuxedo Junc-' and "Kalamazoo," are given the y off-beat rock 'n' roll treatment h sounds rather out of date.

im not fond of the arrangements by ge Tipton, and even Chet Baker's ily supple flugelhorn fails to rescue great old tunes from a run-of-the-studio treatment. If these tunes must iven an 'up-to-date' treatment, then sure Herb Alpert's sensitivity would about a much better result. The ding, however, is excellent, al-gh Baker's flugelhorn needs more ence in "Pennsylvania 6-5000"'

TRADE REVIEWS AND RELEASES

LUX SQ-101 AMPLIFIER FROM ENCEL

The Lux SQ-101 is an all-silicon solid-state stereo amplifier, with excellent physical and electrical characteristics and featuring an unusual degree of operating flexibility. It was sent to us for review by Encel Electronics Pty. Ltd., of 431 Bridge Rd., Richmond, Victoria.

The amplifier is complete in a substantial metal case with a brown wrinkle finish. The extruded aluminium front panel has a satin finish while knobs are satin and fawn, with all functions clearly marked.

Overall dimensions are 14¼ inches wide, 5¼ inches high and 9½ inches deep. The unit gives the impression of robust construction and this is confirmed when the cover is removed, revealing neat design and good workmanship throughout.

The amplifier is of the free-standing type and has been provided with rubber feet for this purpose. Operating facilities are listed in the following paragraphs with appropriate headings and interspersed comment, where appropriate.

INPUT FACILITIES are provided for: (1) Two magnetic pickups; (2) Input direct from tape-heads; (3) Two auxiliary inputs, suitable for tuner, piezo pickup cartridge or tape after preamplification; (4) Tape monitor. (When recording on a 3-head deck from the amplifier's recording outlets, the recorded signal can be monitored direct from the deck's replay head); (5) DIN tape recorder socket.

All inputs are controlled by a Function switch which selects the input, and a Mode switch giving the option of stereo, stereo reverse, and left or right channel through both channels simultaneonsly. Concentrically mounted behind the Mode switch is a Stereo Blend control giving continuous variation between stereo and mono, and intended to minimise the "hole in the middle" effect on some stereo records.

INPUT SENSITIVITY and EQUALISATION: 3mV for magnetic pickups (RIAA); Tape (7½ips) 1.8mV into 100K (NARTB); Tape (3¾ips) 2mV into 100K (NARTB); Aux. 1, 250mV into 250K; Aux. 2, 500mV into 500K. On test, all sensitivity figures were "spot-on" or slightly in excess of the specifications, allowing generous output from typical magnetic pickups, for example with the volume control at less than half on.

OUTPUT FACILITIES: (1) Stereo loudspeaker system with impedance from 4 to 16 ohms from same pair of terminals (polarity marked); (2) Stereo headphone jack mounted on the front panel with speaker silencing switch; (3) Tape recording outlets, the level of which is independent of volume and tone controls; (4) Two unswitched AC outlets.

CONTROLS (apart from those already mentioned): Volume and Tone controls concentrically mounted; Friction-loaded, concentrically mounted Bass and Treble controls, all continuously variable; Rocker switches for tape monitor, speaker silencing, treble cut (scratch filter), low boost; Push-on push-off power switch lights up with the power on; loudspeaker outlets on the back panel.

Non-technical members of the household could probably confine their attentions to the volume control (top left) and the signal selection switch (top right). The remaining control should meet all likely requirements.

The tone controls are unusual in that there are two controls to modify both the bass and treble "corner" frequencies, with facilities to switch each out of circuit to give a flat response. The controls give nominal corner frequencies at 150Hz, 300Hz and 600Hz for the bass control and 1500Hz, 3000Hz and 6000Hz for the treble. In other words, the operator can select not only the amount of boost and cut, but also the range of frequencies whose amplitude is to be modified.

The "Low Boost" switch gives additional bass boost over and above that available from the normal variable controls and, according to the brochure, is intended primarily for low-level listening. The "High Cut" switch also operates independently of the variable controls and is intended for use with old or bad recordings.

In the hands of an audiophile, able to interpret the curves properly, the facilities would accommodate a wide variety of input and listening conditions. Other members of the family may have to be instructec what not to touch!

FREQUENCY RESPONSE: Measurec a level of 100mW into 8-ohm loads "3dB down" points were at 25Hz 60KHz with the tone controls switched of circuit — most commendable figu As could be expected, the square wave sponse at 5KHz was excellent, with no t of ringing.

POWER OUTPUT: This is specified 12 watts per channel into 16-ohm loads 20 watts per channel into 8-ohm lo These represent RMS ratings at 1 per THD and occur above the "knee-po on the manufacturer's published cu where distortion is rising steeply. Our tests indicated 9 watts RMS per cha into 16-ohm loads at 1 KHz and 12.5 w RMS per channel into 8-ohm loads. output was obtained with both chan driven to full power, just before visible o of "clipping," and at approximately 0.5 cent THD.

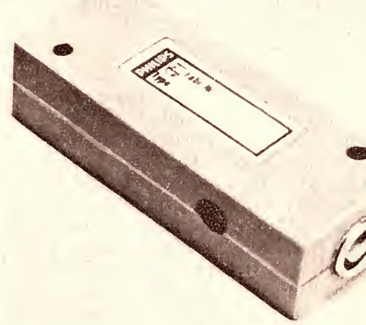
HUM and NOISE: Specifications q 64dB relative to full output for phono puts. In a practical situation, when usir typical magnetic pickup at normal liste levels, the residual noise could only be h very close up to the speakers.

Finally comes the question: "What di sound like?" Connected to good qu loudspeakers and a typical magnetic pic it sounded like any amplifier that is b than its associated equipment and we c have no reason to criticise it on this sc The controls are smooth and positive action with no trace of backlash or n In short, the amplifier is a pleasure to and worthy of a place in any stereo sys

The Lux SQ-101 amplifier is avail from Encel Electronics at $189, comp with handbook containing a full ci diagram and a set of typical frequ response curves. (L.D.S.).

Oscillator/Modulato

PHILIPS ELECTRICAL PTY. LTD. introduced a new oscillator/demodul Type PR9309, which they say can consi ably reduce the cost of relative and absc displacement measurements in industry research. The unit operates—in conjunc with a 12V DC supply unit—as a displ ment to mV converter, and permits the of a cheap and simple moving coil inc tor instead of a more expensive carrier-v measuring bridge normally needed for s applications. Such economies are r marked in applications using several placement transducers, each of which w require its own measuring bridge.



The Type PR9309 allows static displ ment measurements in combination wit moving coil indicator or strip chart rec er. Dynamic measuring results can be corded on a high speed recorder. Meas ments up to 100Hz can be made, whil high measuring stability is ensured thro a temperature-compensated measuring cuit. The carrier frequency of the uni 5.6KHz. The adjustable output is ±1V 10Kohms impedance. Output stability better than 0.05 per cent in 24 hours.

Further information can be obtained f the company's head office at 69-79 Clare Street, Sydney.

REPLACEMENT PICKUP ARMS

'he cheaper type of pickup arm, once so ımon on dealers' shelves, seems almost have disappeared. Dealers can supply number of expensive arms, or complete 'ers but that is all — posing a problem the hobbyist who want to recommission ıld turntable for a secondary role around home. It is of interest, therefore, to note Amplion (A'sia) Pty. Ltd. hold quite d stocks of spare pickup arms and are ing to make them available, while they on a mail-order basis, for $3 net, uding package, postage and sales-tax, he arms are NOT fitted with cartridges. he four types available are as pictured are listed in order, from top to bottom. ł.P.30 — Originally wired and intended mono cartridges but easily rearranged

stereo. Overall length 9 1/8in; pivot to ıs position approx. 7 5/8in. Moulded in k, adjustable height, counterweighted ear. Mounting centres for cartridge ½in, clearance for cartridges ¾in wide.
.P.10 — Intended for mono cartridges wired for same. Moulded in black, 'all length 9 1/8in; pivot to stylus dis- e approx. 7¾in. Mounting centres for ridge ½in, with maximum width of 16in. Internal spring to reduce playing ;ht. Movement would need to be freed ıse with lightweight cartridges.
.P.50 — A lightweight arm, our sample lded in brown. Single-hole mounting :stal, with internal adjustable tension ıg to control playing weight. Overall th 8 7/8in; distance from pivot to ıs position approx. 7 5/8in. Cartridge nting centres ½in, with room for ridge ¾in wide. Wired for mono but ly adaptable for stereo.
.P.78 — Another lightweight arm, over- ength 8 5/8in; distance from pivot to ıs position approx. 7 1/8in. Sample lded in grey. Single-hole mounting pede- with internal tension spring to relieve ing weight; tension adjustable only by ifying spring. Mounting centres ½in for :idges up to ¾in wide. Intended and d for stereo.
ımplion (A'sia) Pty. Ltd., 29 Major's Rd, Concord, N.S.W.).

)W-COST PLANAR TRANSISTORS

AIRCHILD AUSTRALIA PTY. LTD., ɔunces the availability of three new low silicon Planar transistors. The transis- , types AY1101, AY1112, and AY1113, all priced at 26c each for quantities of up.
he AY1101 is a general purpose NPN ɔn Planar transistor which features high er gain, high beta, and low collector ff current. The AY1112 is a high beta V silicon Planar transistor which is ıble for high gain, low noise audio amplifier stages and direct coupled cir- :. The AY1113 is a silicon NPN Planar sistor designed for use in applications iring very high gain, and is suitable for ium power output driver and low power ɔut circuits. Inquiries should be ad- sed to the manufacturers at their head e at 420 Mount Dandenong Road, ydon,Vi-

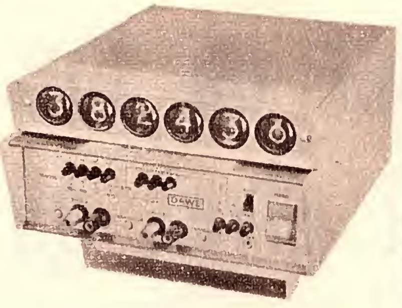
MODULAR DIGITAL INSTRUMENT SYSTEM

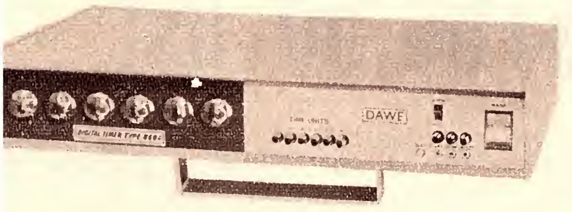
Astronics Imports are Australian agents for a new series of modular digital measuring instruments from Dawes Instruments Ltd. of U.K.

'he 900 Series is a range of digital measing equipment constructed on modular ıciples—i.e., all units are based on a ge of standard modules. In addition, the em includes a range of standard instruıts. By combination of modules, special pose equipment can be provided at comatively low cost, and almost any meaːment can be achieved which involves nt, time, rotation speed, or frequency by correct selection of modules. The sys- offers considerable advantages in flexi-y, since facilities can be extended at any after purchase of a basic system by ition of component modules. Servicing lso simplified, since component modules be easily removed and replaced.

ıll instruments in the range can be plied as a single deck version, with con- and display facilities arranged side by in a single case suitable for bench or mounting (19in); or as a double-deck ion in which the display section is ırately housed so that the two sections be mounted "piggy back" fashion, for where bench space is limited. With this ngement, the display section can be ırated to allow remote display.

he range of instruments currently avail- in the 900 Series comprises digital frency meter counter/timers, ratio meters, ıometers and time/frequency calibrators. ther units are to be added to extend the ge of applications.





Above: Type 983A digital tachometer, slip speed and gear ratio meter, in the double deck configuration.

Left: Type 960A digital timer, as a single deck unit.

he following general data apply to all s in the series:

rystal: 100KHz ± 0.005 per cent.

ʼisplay: 5/8 high, long-life neon numerical indicator tubes; up to six digits can be accommodated.

ɔwer supply: 95V to 125V, or 195V to 250V RMS.

ontrols: All functions selected by push buttons.

emperature range: 0-45 degrees C.

ase dimensions: Single deck: 17.4 x 2.9 x 11.4in. Double-deck: 9.3 x 4.6 x 11.4in (remote display 9.3 x 1.7 x 10.9in)

brochure containing more detailed data the performance of the individual units ıailable on request.

ı addition to the complete digital instruts, Dawes Instruments are making avail- a range of modules identical to those l in the 900 series described above. All s use printed wiring and plug into standsockets. A range of switch units, conors and connector boards is available inter-unit connection. The range com-:s stabilised power supply, display coun- clock generators, double decade divid-control unit, amplifier shaper, inverting er, binary display units. These can be l, for example, to produce equipment :h might form part of a system, be em-ed in other equipment or used to pro- a single non-standard instrument. es have been kept low by the use of the :t Planar transistor techniques and mass luction methods.

ɛamples of the way these modules can ısed to build up systems are given in literature describing the units available. This shows how a simple counter with a count rate up to 400KHz can be built up with a stabilised power supply and one or more display counters; speed and frequency measurement unit over the range 1Hz to 1MHz and speeds above 100rpm; time interval measurement unit from 10uS to 100 million seconds; ratio meter (basically a digital frequency meter or timer or counter without a built-in clock generator); measuring systems for various applications.

Further information, technical literature, and details on prices and availability can be obtained by writing to Astronic Imports at 622-626 Nicholson Street, North Fitzroy, N.7, Victoria; or 121 Crown Street, Sydney.

FREEZER AEROSOL

RICHARD FOOT (AUSTRALIA) PTY. LTD. have sent information on Electrolube Freezer, which is a freezer aerosol with a number of applications in electronics work. For example, when a fault such as discontinuity, instability, intermittence or drift occurs in a piece of equipment, this is often the result of temperature rise in some heat sensitive component, particularly those provided as thermal compensators. The Electrolube Freezer aerosol can is provided with a thin tube which allows a fine jet of the freezing reagent to be directed with controlled precision to components in turn, thus allowing the faulty component to be isolated.

Another use for the aerosol is prevention of heat damage to heat sensitive devices such as transistors and diodes. A brief spraying of components with the freezer prior to soldering or desoldering will protect them from the effects of heat for a limited time. Checking and resetting of thermal cut-outs, thermostats and similar devices is simplified by using the aerosol to reduce their temperatures below ambient.

The freezing reagent is harmless to polystyrene and other thermoplastics, is non-toxic and non-inflammable. The aerosol also deposits a protective film over components and connections which inhibits the effects of moisture, such as tarnish or corrosion, which might otherwise result from the formation of ice during the freezing process.

Electrolube Freezer is packed in a 6oz aerosol can, and the retail price is $1.75, including sales-tax.

RADE RELEASES—IN BRIEF

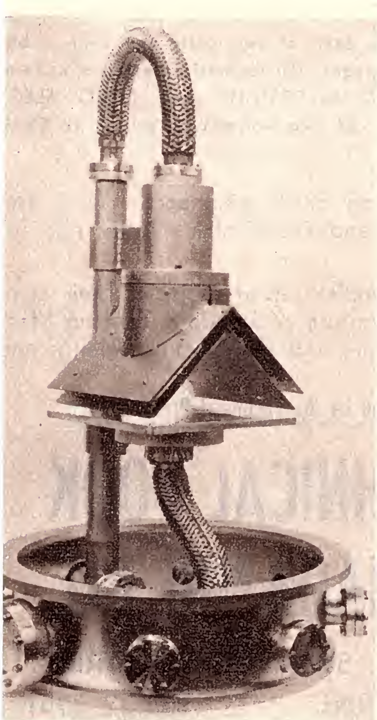
NERAL ELECTRIC COMPANY, in ‚., now has a complete family of gate ›lled AC switches (Triacs) following : additions to its range. These devices ow available with RMS currents from › 15A and for voltages from 50V to

ɛse Triac switches, which will perform of the functions of two SCRs connec- n inverse parallel, are designed for 240V and 277V 50Hz or 60Hz switch- nd control applications, such as lamp ing and temperature controlling. An nding feature of their performance is ability to withstand high peak one surge forward currents (IFM). In the ɔf the 6A version, IFM surges of 50A ɪe tolerated. For the 15A version, the figure is 100A.

ther details and technical data can be ıed from Australian General Electric .td., 103 York Street, Sydney.

ANDARD TELEPHONES AND LES PTY. LTD. has announced the ntment of Mr Norman C. Stevens as ınt managing director in charge of the tions of the company's Liverpool Mr Stevens was formerly the general ger of Ducon Condensers Pty. Ltd. ıppointment of Mr Stevens has released other assistant managing director, Mr Scott, from his duties at the Liverpool y, and he has returned to the com- s head office at Alexandria, Sydney.

RIAN PTY. LTD., 38 Oxley Street, 's Nest, N.S.W., has forwarded infor- n on a new 6KW evaporation source ıed to provide rapid, ultra-pure thin- leposition. Virtually all laboratory and ıction microelectronics and optical ıg applications can be served by this ɛ, the company says. The source is to install in a vacuum system and can ɪerated from either on-panel or remote ɔls. It creates temperatures up to deg. C which can quickly evaporate a range of materials (for example, nium at 3750 angstroms/minute and ım at 10,000 angstroms/minute). The e is compatible with a vacuum down to 1 x 10^{-11} torr and can be baked to 250 deg. C. For purity of film deposition, a tightly focused electron beam is magnetically bent so that it strikes the evaporant which is shielded from bombardment by the heated filament.



an RF-Plasmapeak Sputtering System.

Another new instrument from Varian is the RF-Plasmapeak sputtering system, introduced by the Varian vacuum division. This is intended for pure, high-vacuum deposition of any material—metal or dielectric. The sputtering module has a water-cooled target consisting of two square plates set at an angle. These are biased with 1.2KW DC at a radio frequency of 13MHz. Deposition rates on a horizontal 10in sq. substrate holder range from 250 angstroms/minute for dielectrics to 500 angstroms/minute for metals such as copper. A data sheet is available on request.

FERRIS BROS. PTY. LTD., Channel Master Division, has released the Vu-Tron transistorised battery operated booster and distribution amplifier Model 0024-B. This is a single-unit broadband all-channel amplifier of compact design fitted into a plastic case provided with wall mounting feet or brackets. It is intended as a TV aerial booster on boats, caravans, camps, etc., or as a small distributing amplifier in country homes. The unit is self-contained, and provided with leads for connection to 12V-24V and 32V battery supply. It has an inbuilt protective diode, and isolation which allows the unit to be used with floating battery supply, or where positive or negative of the system is grounded. An ON/OFF switch is provided for primary battery operation, but where the unit is connected to a secondary battery it may be left connected continuously if required.

Brief technical data are: Designed for either 75-ohm coaxial cable or 300-ohm line input, output 300 ohms to one to four TV receivers; covers all Australian TV channels, channel coverage 45MHz to 222MHz; gain, 12dB minimum, 16dB maximum; noise figure, 3.5dB minimum, 4.5dB maximum.

Retail price is $35.70, including sales tax. A full range of accessories is available. Further details can be obtained from the company's head office at 752 Pittwater Road, Brookvale, N.S.W., or branch offices in all States.

HEWLETT-PACKARD AUSTRALIA PTY. LTD. has been formed as the local marketing organisation of the Hewlett-Packard company, of U.S.A., effective from July 1. The new company will be under the general management of John A. Warmington, with head office at 22-26 Weir Street, Glen Iris, S.E.6, Victoria, telephone 20-1371. A branch office has been established in N.S.W. at 4 Grose Street, Glebe, telephone 69-6338. Under an arrangement with Sample Electronics, the company's former agents in Australia, the new Australian subsidiary will be staffed primarily with the same personnel who have been handling Hewlett-Packard products at Sample Electronics.

NIMEX PTY. LTD., Old Pittwater Brookvale, N.S.W., has released the atch of Australian made pre-recorded Hanimex are also currently the only ılian manufacturer of domestic tape lers.

ıimex are putting out both two-mono and four-track stereo tapes on ch reels. Retail prices are: mono, stereo, $8.50. Among the first released selection of titles by Herb Alpert and 'ijuana Brass. They plan to extend nge to include both popular and light al music, selected from major world gues for which Hanimex have exclusive ecording rights in Australia.

ers may be placed directly with the ıex branch in all capital cities ex-Iobart. A list of titles in the first re-and branch addresses can be ob-from Hanimex Pty. Ltd., at the ss given above.

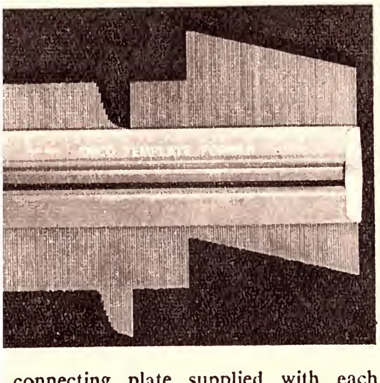
ERSON AND CUMING, INC., of n, Massachusetts, U.S.A., has supplied ıation on the following products:

osorb TE are waveguide terminating nts. The terminations, in the shape ottom-wall wedges, are made from dielectric absorbing material. In use, de of the wedge is mounted in contact the bottom (broad) wall of the wave-This provides a rugged structure ed to withstand more abuse than the ıidal type of structure.

ofoam EFF-14 is a one part epoxy sulant with a density of about 14 ls per cubic foot. It is supplied as a er which is vibrated into the cavity filled and then heat treated to effect Cure temperatures as low as 80 deg. C be used where components cannot posed to higher temperatures. Where of cure is important, higher tempera-may be used.

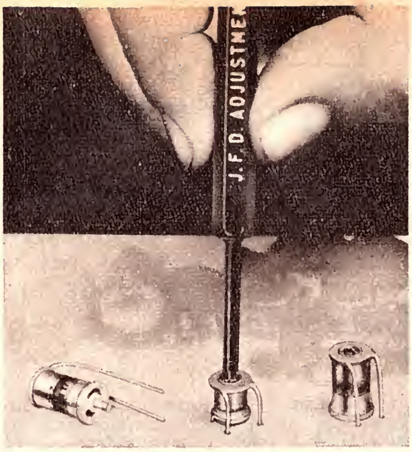
obond PDQ is a two part epoxy ad-that sets within one minute after mix-The manufacturers state that it is use-or joining metal, glass, ceramics and plastics where bonding speed if of ıount importance. Small quantities are together and applied immediately to urfaces to be bonded. The mix ratio arts of A to one part of B by weight. tails are available from the company's ralian agents, Wm. J. McLellan and Pty. Ltd., The Crescent, Kingsgrove, V.

OMAS BUDDEN PTY. LTD., 59 e Street, Crow's Nest, N.S.W., advise the Temco adjustable template former, has been in short supply for almost r, is now readily available in Australia. device comprises a pack of sliding ıed steel needles held in a frame by a it friction device which enables the es to reproduce accurately and simul-ously a positive and negative profile of projection or form to which the needles applied. Each unit allows a profile of oximately 6in to be taken, but a swivel-



connecting plate supplied with each allows any number of formers to be ed to cope with larger profiles.

ıe range of applications is said to be ıally unlimited, ranging from ship build-to anthropology, architecture to lino laying, tool making to jobs around the home and many others. The device was awarded a gold medal at the last International Inventors' Exhibition, in Brussels. It is sold in two packs—in a plastic wallet and in a blister type pack. Suggested retail price is $4.50 for the wallet pack and slightly less for the blister pack.



DUCON DIVISION of the Plessey Components Group is stocking a new universal top tuning piston capacitor made in U.S.A. by JFD Electronics Co. These are available in two-wire and pin or four-wire configurations for printed wiring board mounting. The unit illustrated has a range from 2pF to 25pF, a working voltage of 500V DC, a Q of 600 at 20MHz and insulation resistance of 10^6 megohms. The tuning torque is 1 to 10 in/oz. Dielectric strength is 1000V. Details of the full range available can be obtained by writing, on company letterhead, to Ducon Components Division, P.O. Box 2, Villawood, N.S.W.

THE PLESSEY CO. LTD. and **THE GENERAL ELECTRIC CO. LTD.** in U.K. have signed a 15-year agreement in the field of public telephone exchange equipment. The agreement provides for: Collaboration in research and development; pooling of facilities to offer countries throughout the world total communications networks, comprising exchange switching equipment, transmission and other telephone plant; both companies to manufacture and sell the 5005 crossbar system developed by Plessey.

The announcement by the companies says they see this as an important measure of rationalisation in the U.K. telecommunications industry. It is expected to provide the conditions to meet better and sooner the technical and production needs of the British Post Office and overseas markets.

MAGNA ALLOYS AND RESEARCH PTY. LTD., 21 May Street, St. Peters, N.S.W., advise that their Corium Chemical Division has produced an insulating material in liquid form which is applied from an aerosol can to form a tough, flexible, oil-proof film. Called Corium 202, the liquid chemical dries within minutes of application. The material when cured is said to have high dielectrical properties which make it a very efficient insulator. Exposed electrical systems can be quickly and economically sprayed with Corium 202 to ensure protective insulation. The product seals out moisture, salt spray, corrosives and undesirable atmospheres. It is said to be ideal for use with diodes, printed circuits, motorhousings, wiring systems, instrumentation and all electrical systems. Dielectric strength is 1000V per mil.

TECHNICAL BOOKS AND PUBLICATIONS

Fortran IV — "commendable volume"

INTRODUCTION TO FORTRAN IV PROGRAMMING, by Donald Dimitry and Thomas Mott, Jr. Published by Holt, Rinehart and Winston, Inc., New York, 1966. Soft covers, 6in x 9in, 334 pp., many diagrams. Price in Australia $6.25.

Fifty years from now, if mankind has still not succeeded in vaporising itself, the present era will no doubt be regarded as but the pioneering stage of the computer revolution. Our present machines and computing techniques will likely seem rather quaint and clumsy then, even though they now seem quite complex and refined by comparison with previous facilities. Not only this but the present extent of our application of computing will probably be seen as but a scratch upon the surface of ultimate applications.

It is books like that which forms the subject of this review which will contribute greatly to this progress. Not so much by training professional "programmers," I imagine, but by placing programming knowledge and skills in the hands of the people who will really extend the applications of computing—those with the problems to be solved. It is only when the engineer, the scientist and the artist become properly aware of the potential of computers that the computing revolution will be really under way, and one of the requirements for this to occur are that there will need to be many books to disseminate the basic knowledge.

The present volume is intended as an introduction to what is probably the most widely used programming "language" in current use—Fortran (the name standing for FORmula TRANslation). More specifically, it deals with Fortran IV, the most recent version of the language, in the particular "dialect" used with the IBM 7040-7044 computer systems. However the discussion is sufficiently general to be of considerable value to anyone wishing to develop a basic understanding of other Fortran versions or dialects as appropriate to other machines.

The book is designed to be self-sufficient for the student with no previous detailed knowledge of computers or programming and, to this end, the first three chapters explain in some detail the basic concepts involved in both the digital computer itself and its direction. The first chapter discusses the basic elements and operation of a digital computer; the second discusses number systems and coding; while the third explains the three "levels" of programming languages—machine, symbolic, and machine-independent or "problem orientated," into which latter category falls Fortran.

The remainder of the book then deals with the Fortran language in detail, discussing in turn arithmetic statements, types of variable and constants, functions, transfer and program control, input/output, subscripted variables and DO loops, subroutines, equivalencing and COMMON statements, advanced input/output, logical operations, double precision and complex arithmetic. Finally there are some 25 sample programs and problems, all of which have been tested with a computer to ensure their correctness, and a selected bibliography.

Throughout the text seems very well written. The explanation is clear and concise, and well illustrated with examples. Important definitions and statements are isolated with rules for easy reference at a later date, and every chapter ends with a short set of practice problems.

In short, a highly commendable volume from all aspects, and one which would make an excellent introduction to the Fortran language. It will probably be of value to almost every progressive scientist and engineer.

Our copy came from the Australian and New Zealand distributors for the publisher, Rigby Limited. We understand that copies will be available from the larger bookstores by the time this review is published. (J.R.)

Examples — physics

WORKED EXAMPLES IN MODERN PHYSICS, by P. Rogers, M.Sc., and G. A. Stephens, Ph.D. Vols. 1 and 2. Published by Iliffe Books Ltd., London, 1967. Soft covers, 5½in x 8½in. Volume 1: 126 pp., 12 diagrams. Volume 2: 100 pp., 20 diagrams. Price in U.K. 18/6 each volume.

These volumes are intended primarily for undergraduates in Science and Engineering courses. They contain a selection of actual examination questions from several English universities and colleges and, since English standards are probably broadly similar to those in this country, the examples may accordingly be useful to Australian students in the later years of their courses.

The contents are as listed below:

Volume 1:

ATOMIC and ELECTRON PHYSICS: Mass spectrometers, motion of charged particle in electric and magnetic fields, charge on an electron, photo-electric effect, the Bohr atom, Zeeman effect, etc.

NUCLEAR PHYSICS: Radioactivity, equivalence of mass and energy, nuclear reactions, nuclear reactors, nuclear instruments, etc.

Volume 2:

X-RAYS and ELECTRON PHYSICS: Origin of X-rays, adsorption of X-rays, Bragg's Law, missing orders, etc.

SOLID STATE PHYSICS: Lattice energy of ionic crystals, magnetic properties of materials, point defects, free electron and zone theories, free charge carriers in metals and semiconductors, etc.

WAVE MECHANICS: Dualism, Heisenberg uncertainty principle, Schrodinger Equation, etc.

SPECIAL THEORY of RELATIVITY: Michelson-Morley experiment; the Lorentz transformation.

The books assume that the reader has full knowledge of the topics, and are only concerned with giving a straightforward method for solving the problem in hand. After giving the method for a particular type of problem, further unworked examples with answers are given for exercise. All in all, this book would be very handy to students doing this subject.

Our copy came direct from the London publishers but it is likely that copies will be available from local technical bookstores in the near future. (L.D.S.)

Amplifier Fundament

FUNDAMENTALS OF VACUUM-T AMPLIFIERS. Published in U.S.A Techpress Inc., Brownsburg, Ind Stiff paper covers, 6in x 9in, 30 Price in Australia, $4.75, postage

This book is a condensation of one series of U.S. Navy training manuals c ing "Fundamentals of Electronics." Th not divided into numbered chapters, nevertheless fairly complete in itself study of audio amplifiers, with only p references to RF amplifiers.

Though the publishers describe "basic" and "down to earth," it is much a book for students, not for begi Throughout, the text is heavily depe on graphs and mathematical expres Again, "j" appears without introducti an elementary treatment of impe coupling and, later, when equivalent ci are discussed in some detail, co numbers are used as a matter of c

The first section on triode amp includes a very thorough introductic valve theory. Topics covered include current control, characteristic curves, load line and load line analysis, class operation, biasing methods, coupling, meters and equivalent circuits. A large of this section deals with amplifier quency response including response and deals at some length with equi circuits at midband, low-frequency high-frequency using complex no throughout.

The second section deals with te and pentode amplifiers, with a thorough analysis of gain and freq response of the latter. The third s deals with paraphase amplifier circui phase splitters as they are more com called.

Section four is devoted to the power amplifier and although desc both single-ended and push-pull ci adequately, much of this section is up with a description of beam power v The final section covers decibels, r phones (including the nature of sound the dynamic speaker.

A number of questions are includ the end of each section, but witl answers given. Other questions are sca indiscriminately throughout the text, short answers appearing a few pages often in mid-sentence, thereby disru the smooth reading of the main tex

Review copies were received direct Technress; also from the Technical and Magazine Co. Pty. Ltd., of 28 Swanston Street, Melbourne, C.1, Vic who have copies available from stock.

Amplitude modulatic

PRINCIPLES OF AMPLITUDE M LATION. Published in U.S.A. by press, Inc., Brownsburg, Indiana. paper covers. 6in x 9in, 80 pp. Pr Australia, $2.35, postage 15c.

This rather modest book been compiled for High-school cated students and is, in endorsed "Not An Engineering Text covers the fundamentals of amplitude n lation on a straightforward manner very little mathematics. Most of the bo purely descriptive, as would be expect an introductory text of this nature. It sl be noted, however, that only AM tran sion is discussed, the problems of dete being left out of this treatise.

Some idea of the contents can be de from the section headings: Ampl Modulation; Plate-Modulator Ana AM-Wave Analysis; Vector Analysis; tional Modulation Systems. The boc quite comprehensive, but it does empl plate modulation in preference to methods, which are relegated to the section. The second section describes to derive a transfer curve and explain ion of the plate modulator. The third ı includes an analysis of the power carrier and sidebands, while the final ı includes a brief description of how ck the percentage of modulation.

book includes a selection of questions end of the book as exercises, but no answers. It also has a selection of ›ns in the text of the book with the ·s appearing rather disconcertingly l pages later. This tends to disrupt the uity and therefore does not assist r.

nded primarily for the vast number itizen Band" operators in the U.S., ›ok should be of some value to Aus- hobbyists, amateurs and others who to learn the fundamentals of ampli- ıodulation and how modulators work. iew copies were received direct from ress; also from the Technical Book Iagazine Co. Pty. Ltd., 289-299 Swan- treet, Melbourne, C.1, who have copies ›le from stock. (J.H.)

ments of Hi-Fi

TROUBLES . . . How You Can void Them . . . How You Can Cure hem. By Herman Burstein. Number 20 of the Gernsback Library series, ew York. Stiff paper cover, 159 pages, ‡ x 5½ inches, freely illustrated with ne drawings.

an author on hi-fi topics, Herman in will be well known to readers of can technical journals and, in fact, of the material in this book has been ed from articles by the author which already appeared in "Audio," "HiFi Review" and "Radio Electronics."

book has been compiled primarily i-fi enthusiasts to whom the various components in a hi-fi system are · "black boxes." The author makes no ›t to explain the intricacies of circuit or, for that matter, of component . In this respect, the title could be ding to those who might look upon ook as a tutor for repairing faulty iers, etc.

author's objective rather, is to ex- the characteristics and roles of the components in a hi-fi system, the ds and problems of interconnecting ıstalling them as a system, and to edu- i-fi enthusiasts into all aspects of their ıs, short of actually diving into the ls. There is certainly plenty of scope, up to this limiting point, and the r appears to have provided an excel- overage. One thing is certain, if local ıiasts were to absorb the contents s book, there would be fewer inquiries how to connect which to what, and loesn't it work?

jects covered in a total of 11 chapters e, audio troubles, tools of trade, ele- ry troubleshooting; problems to do hum, noise, bass, treble, distortion, . A final chapter has to do with build- rself kits.

short, a most useful book for the un- ed. Our copy came from the Gren- Publishing Company, 154 Clarence St, y. Copies are available from technical hops; Aust. price $4.95. (W.N.W.)

ırier Transform

FOURIER TRANSFORM AND ITS ıPPLICATIONS, by Ron Bracewell. 'ublished by McGraw-Hill Book Co., nc., New York, 1965. Hard covers, ¼in x 9¼in, 381pp., many diagrams. 'rice in Australia $12.35.

recent addition to McGraw-Hill's established and highly esteemed Elec- and Electronic Engineering Series is olume on the Fourier transform, writ- ›y Professor Bracewell of Standford ersity's school of Electrical Engineer- The author states in his preface that ›ook is a culmination of an interest e subject which first started in 1939 he was a student at the University of :y.

: book is aimed at those already pos- g a first degree, with the idea of providing them with a sounder and basic grasp of the Fourier transforr its applications than is normally ac "along the way" in post-graduate stuc approach is an honestly practical one cerned with the application of Fourier forms to physical situations rather with furthering the mathematical s for its own sake.

The original idea was to produce torial guide or "atlas" to Fourier forms, with diagrams of the appr functions and transforms to comp the standard pair lists. However, the found that as the work progresse major weight of the content, and the itself had grown to full-scale text.

Although this might lead one to that the book would be unwieldy and ing, such is not the case; or at l seems so to this reviewer. In fact it to be extremely well written, with a mendable balance between mather conciseness and the detailed disc necessary to fully explain the conce volved. So successful is this balanc the book seems eminently suitable f purpose intended.

The chapter headings give a goo of the scope covered: 1—Introductio Groundwork; 3—Convolution; 4—N for some useful functions; 5—The i symbol; 6—The basic theorems; 7— transforms; 8—The two domains; 9- trical waveforms, spectra, and filters Sampling and series; 11—The Laplace form; 12—Relatives of the Fourier form; 13—Antennas; 14—Television formation; 15—Convolution in sta 16—Noise waveforms; 17—Heat conc and diffusion; 18—Pictorial Diction Fourier transforms; 19—Appendix.

Each chapter ends with a set of pro and chapter 2 includes a bibliography.

To summarise, an excellent text Fourier transform and its applicatio the engineer and graduate student.

Our copy came from the publishe we understand that copies are availa all comprehensive booksellers. (J.R.)

Electron Physics

PHYSICAL ELECTRONICS. I Paperback No. 5, by B. Urgosik lished by Illiffe Books Ltd., L Stiff paper covers, 189 pages, si 5½ inches; numerous diagrams.

The average electronics engineer do greatly concern himself with the fin tails of sub-atomic particles. He a their existence, their electrical charg certain behaviour patterns in vacuun liquid and solid—but only to a degree sary to an understanding of electronic ponents and circuits.

The emphasis of this book is all the way. The author introduces electron cepts, electron behaviour in metals, el emission, electron tubes, etc., in muc same manner as one would expect to any one of a large number of elect textbooks; but instead of using this starting point to orientate the fact or in respect to external circuitry, he t long, introspective look at the laws an tors which cause the electron to beh they do.

The publisher's own notes descrit book quite accurately: It begins by sing methods of producing free electro ions and then devotes a chapter to tron ballistics" in which the moti charged particles is considered. Succ chapters deal with the electron as a p and a wave, with primary and secc emission of electrons and the behavic electrons in metals and gasses. Elec optics are considered in some detai chapters are devoted to electron tube mass spectrometers. All the more imp aspects of the subject are considered the exception of plasma, which is the ject of a separate paperback: "Fourth Of Matter."

(This last-mentioned title was review I. L. Pogson in our June issue, page and commended for its compreh coverage of the subject.)

shed in the first instance, in Prague
l, this present English translation
the dateline 1966. It is not a preten-
ook and at 17/6 in England is not
ensive one; but it is packed with
tion, freely illustrated with explana-
igrams and should be most valuable
ieers and engineering students whose
r studies dictate that they should
re than the usual amount of atten-
what goes on inside thermionic and
te devices, from diodes through to
opes, magnetrons, klystrons and
ectrometers.
copy came direct from the publishers
s reasonable to assume that supplies
available through technical book-
Price in Australia has not been
(W.N.W.)

ıents of SCR's

**OF SILICON CONTROLLED REC-
FIERS, by Allan Lytel. Originally
olished in U.S.A. by Foulsham-Sams
chnical Books. This edition publish-
in U.K. by W. Foulsham and Co.
l., Slough, Bucks, with an introduc-
n for the English reader by W.
iver. Hard covers, 5½in x 8¾in,
3pp. Price in Australia, $2.72.**

is a simple introduction to the
controlled rectifier, or thyristor. The
overs the following topics in varying
s of detail: Basic principles, includ-
ni-conductor theory, how the SCR
and using the SCR; SCR character-
ncluding how to read specifications,
rn-on and turn-off methods; Static
ıg, AC and DC; Phase control, in-
magnetic triggers and unijunction
ors; Motor control; Applications of
R, including lighting control, and
iture control; Related switching
including the four-layer diode and
t-activated SCR.
the technician, hobbyist, or student
familiar with transistors, this book
rm a useful introduction to SCR's,
s selection of possible applications
periments.
w errors have crept in which should
ly obvious to all but the absolute
r. One in particular is due to over-
cation in the introducory section
ng semi-conductor theory. Here the
states: "A diode is formed by press-
gether two pieces of semi-conductor
l, one p-type and one n-type."
review copy came from Grenville
ing Co., 154 Clarence Street, Sydney.
should be available from technical
ops. (J.H.)

ımes on Antennas

**NNA HANDBOOK by Glanzer,
olume 1: Theory and Practice. Pub-
ed by Cowan Publishing Corp., 14
ndervенter Ave., Port Washington,
Y. Soft covers, 8¾in x 5¾in, 109pp.,
ny diagrams. Australian retail price
.95, postage 15c.**

little book is the first of a set of
olumes. Although we have not seen
ier two volumes, it is expected that
ill be available shortly. Information
le indicates that this work has taken
years of research and preparation
at the approach to the subject is
d not just a re-hash of old material.
eful perusal of Volume 1 seems to
e that the method of attacking the
matter is different from the usual
clear and well presented.
first chapter is devoted to trans-
ı lines and the subject is treated at
erable length. This is a subject that is
all easy to get across to the reader
is treatment is so well illustrated that
hould be no difficulty in grasping this
antenna theory.
"characteristic impedance," or Zo. is
mes found difficult to grasp by some
ts. Also, the reason why the standing
ratio differs when measured at the
itter end, from that measured at the
end of the transmission line, is given
reatment. In short, the author has a
thorough grasp of the subject and he is also able to impart it to others.

Chapter two is devoted to antenna fundamentals. This begins with the theory of radiation and the concept of electric and magnetic fields at right angles to each other. This is followed by a short discussion on radiation resistance. Then follows the half-wave dipole and aerials progressively longer than one half wavelength. Third dimensional radiation patterns are given and these give a clear picture of the actual pattern, which is so often lacking when this material is being covered.

The third chapter deals with matching devices. Such methods as the Gamma match, T-match, Delta match, Folded Dipole matching and Quarter-wave stub matching, are included. These are followed by the use of baluns and methods of feeding multiple antennas and stacked beams.

To sum up, I think that this work is well worth looking into and on the assumption that the other two volumes are as good, there should be a wealth of information to draw upon, for the reader who has a real interest in antennas. One point however, may stand in the way of some would-be buyers and that is the price. However, this is a matter for the individual to decide.

Our review copy came from the Technical Book and Magazine Company Pty. Ltd., 289-299 Swanston Street, Melbourne C.1, and we understand that copies are now available from stock. (I.L.P.)

LITERATURE—in brief

STANDARDS ASSOCIATION OF AUSTRALIA has issued Australian standard AS K158, covering the quality of electroplated coatings of gold in engineering applications. The standard provides for 12 coatings, ranging in thickness from 0.5 microns to 125 microns. It recognises four types of coating, according to gold content, and specifies hardness, adhesion, porosity and corrosion restance. Tests for proving compliance with the specified requirements are described, including a method of assessing the composition of the coating. Copies of the standard are available from the various offices of the association for 80c each, post free.

ADVANCED MICROWAVE TUBES FOR ADVANCED SYSTEMS is the title of a new four-page shortform catalogue produced in U.S.A. by Varian Associates. It lists the complete lines of CEM and ICEM coaxial magnetrons, CW and pulsed crossed-field amplifiers, and high-power noise generators available from S-F-D Laboratories, a subsidiary of Varian Associates. Inquiries should be addressed to the Australian company, Varian Pty. Ltd., 38 Oxley Street, Crow's Nest, Sydney.

ANODEON SALES DIVISION has published a data sheet covering Anocap polyester film capacitors, now being manufactured by a new division of Electronics Industries Ltd. This lists the full capacitance and voltage ranges at present available, explains how to interpret the numbering code, contains typical performance curves and general information on construction and operating conditions. The sheet is obtainable from Anodeon Sales Division offices at Electronic City, 443 Concord Road, Rhodes, N.S.W.; or Electronics Park, Hamilton Street, Huntingdale, Victoria.

MULLARD OUTLOOK, Vol. 10, No. 2 (March-April, 1967) is a special I.R.E.E. Convention issue, with 24 pages. Articles included are: Philosophy of Mullard Integrated Circuit Data Presentation, which explains the method of presenting data on integrated circuits adopted by Mullard; Integrated Circuit Logic Applications, which deals with the uses for Mullard OMY range of integrated circuits in industrial applications, and has an introduction to logic theory; Integrated Logic Circuits, which gives details of the Mullard OMY100 range of logic devices; Dynamic Display Means Extra Sales. Part 4 — The Interior. (One of a series to assist retailers to understand the principles of good display.)

Mullard Outlook is published by Mullard-Australia Pty. Ltd., 35-43 Clarence Street, Sydney.

MINIWATT DIGEST Vol. 6, No. 6 (March-April, 1967) is devoted entirely to Part 3 of a series of articles on Digital and Logic Systems. Entitled "Applications of Integrated Circuits," Part 3 considers counting in the binary system, and illustrates this by introducing applications of the Philips range of integrated circuits in some counters of various cycle lengths. Practical circuits given are a shift register, decading circuits, and a free-running clock; also a time delay generator constructed from the standard positive NAND gates. Miniwatt digest is published by the Miniwatt Electronics Division of Philips Electrical Pty. Ltd., 20 Herbert Street, Artarmon, N.S.W. Subscription rate is $3 per volume, post free. Single copies cost 50c each, post free.

WESTINGHOUSE ELECTRIC CORPORATION, Semiconductor Division, of U.S.A., has published the "Westinghouse Semiconductor Replacement Guide, containing a cross reference of power transistors, thyristors (SCR's) and rectifier replacements. Outline drawing showing dimensions of the various configurations available are also included. Inquiries should be addressed to the Westinghouse agents, who are Email Ltd., Joynton Avenue, Waterloo, N.S.W.

STC COMPONENTS REVIEW, Vol. 4, No. 4 (April, 1967) has information on: three new variants of the ITT type 24 and 25 miniature relays — magnetic latching, twin contact and AC versions; miniature aluminium electrolytic capacitors; STC solid tantulum capacitors which are qualification approved by the joint services R.C.S.C.; three ITT silicon diodes suitable for use in power supplies. The same issue also has the continuation of an application note on VHF/UHF power transistor amplifier design, begun in earlier issues. Inquiries to Standard Telephones and Cables Pty. Ltd., Moorebank Avenue, Liverpool, N.S.W.

NEW DEVELOPMENTS, the new products magazine of Jacoby, Mitchell and Co. Pty. Ltd., describes the following items: Advance Electronics new 2MHz timer counter TC7; PRD Electronics, Inc. thermoelectric power meter Model 6685; Alfred sweep oscillator Model 6400 series; Wiltron Company fidelity test sets, Model 701 (voice bandwidth), Model 332 (envelope delay measurements, 30KHz-5MHz), Model 601B (swept frequency generator, 50KHz-100MHz), Model 350 (LF phase meter, 10Hz-2MHz), Model 321 (phase and amplitude meter), Model 322 (local oscillator, 2.5-100MHz), Model 323 (local oscillator, 100-400MHz), Model 335-336 (wideband FM time delay analyser), Model 310B (multifunction phase amplitude and impedance analyser; TRW Semiconductors new 2GHz UHF transistor Type 2N4976; Sony Model TC-530 tape recorder. Further details can be obtained from the company's head office at 469-475 Kent Street, Sydney.

NATIONAL BUREAU OF STANDARDS in the U.S.A. has advised publication of the following:

Experimental Statistics, by Mary Gibbons Natrella. N.B.S. Handbook 91; August 1, 1963, reprinted October, 1966 with corrections; 544 pages. Price $US4.25. This handbook contains a collection of statistical procedures useful in the design, development and testing of materials; in the eval of equipment; and in the conduc interpretation of scientific experime is intended for the user with an engi background who occasionally needs statistical techniques, but who do have the time or inclination to beco expert on statistical theory or metho

Electrical Parameters of Precisior axial, Air-Dielectric Transmission by Robert E. Nelson and Marlene R. ell. N.B.S. Monograph 96, June 30, 103 pages. Price $US1.25. This pap vides graphs from which the el parameters of lines can be dete rapidly and accurately.

These publications can be obtaine the Superintendent of Documents, Government Printing Office, Wash D.C. 20402. Remittances must be i exchange and should include an ad 25 per cent on the price to cove charges.

ANODEON SALES DIVISION ha able the following technical data:—

Transistor Interchangeability Lists popular transistor portable and car including Japanese brands.

Condensed Catalogue No. 10, Se ductors.

Condensed Catalogue No. 7, Tubes.

Engineering Data 660524, silicon re AD100 and AD1000.

Engineering Data 280764, silicon fiers 1N3659-3660-3661.

Engineering Data 650202, silicon fiers 1N3253-4-5-6.

Inquiries to Anodeon Sales Divisior tronic City, 443 Concord Road, F N.S.W., on company letterhead.

EMERSON AND CUMING, IN U.S.A., has a fold-out chart for no or wall mounting which describes th pany's range of general purpose and alty epoxy moulding powders. Infor is given on physical form, bulk f flow grade and colour choices c powders, and several applications a strated by photographs. Processing tions, such as the moulding tempe pressure and shrinkage are also Mechanical properties of the cured m listed include maximum operating te ture, tensile, flexural and comp strengths, and thermal properties. Di constant, loss tangent, volume resistiv dielectric strength are also given. An cation selector table lists a large r of electrical and electronic parts wi recommended powder. Inquiries sho addressed to the company's agents, J. McLelland and Co. Pty. Ltd. Crescent, Kingsgrove, N.S.W.

BBC ENGINEERING MONOG NO. 66 (February, 1967) entitled aerial gain calculation using tab mutual resistance between the radiati ments," has been published by the in London. The authors are P. B.A., M.I.E.E. and R. E. Davies, M. text covers: Gain computation from resistance — The computation of mutual resistance for vertical radiati ments, tangential radiating element radial radiating elements — The g a single element — Verification method of computation.

The monograph can be obtained BBC Publications, 35 Marylebone Street, London, W.1. The price is 5 free.

RF POWER TRANSISTORS is a selection guide and graph for RF transistors featuring overlay constr and includes both RCA and J.E. designations. Copies can be obtained Amalgamated Wireless Valve Co. Pty of 348 Victoria Road, Rydalmere, N

"QUARTZ CRYSTAL UNITS" booklet giving details of the Pye ra crystals and explaining how to specif order these crystals. Copies are av free on request from Pye Pty. Ltd., Division, 59 Arundel Street, Forest Sydney, N.S.W.

AMATEUR BAND NEWS AND NOTES

"Australis I" Satellite Shipped to U.S.

'he Australian Amateur Satellite AUSTRALIS I, now offic-ally known as "Australis Oscar A," was shipped to the United States on June 1.

By Pierce Healy, VK2APQ*

"Australis Oscar A" amateur radio te, built by the Melbourne University ıautical Society and the Melbourne rsity Radio Club, was airfreighted to Francisco for delivery to Project . Three members of the Project team the Melbourne University, Messrs Dunn, Owen Mace and Richard n, will accompany the satellite to the l States. They will conduct special on the satellite, as well as having sions with officials of Project Oscar.

departure of the satellite for the . comes just 15 months after the final was approved. The satellite has been on an entirely voluntary basis — of the constructors received any pay-for the work they did on the project. most of the electronic components in "Australis Oscar A" were donated ıstralian firms. The Wireless Institute stralia gave the project a $400 grant e purchase of special materials and ›nents, and the Melbourne University . gave a special grant of $750.

ıstralis Oscar A" is a 35 pound gular satellite, measuring 17 inches by ches by 6 inches. The aluminium has been specially strengthened to and the acceleration and vibration of unching into orbit. The satellite will ermally controlled by a black and paint pattern, which will be applied U.S.A. It is hoped that the internal ·ature of the satellite can be kept a range of 60 deg. to 100 deg. F, gh all units have already been tested 20 deg. to 200 deg.

stralis Oscar A" is a test bed for s that will be used in later amateur satellites. It will transmit information e performance of these systems to ır radio tracking stations around the The telemetry system in the satel-as been specially designed so that amateurs can decode the information ıitted from Australis Oscar A. using ely inexpensive equipment. It will take few minutes to decode this informa-sing charts which will be supplied to io amateurs tracking the satellite.

satellite carries two transmitters ing in the international amateur radio One transmitter operates on a fre-' of 144.050MHz. This transmitter n average output of 100 milliwatts vill operate continuously from the he satellite is put into orbit until its es are exhausted, about two months aunch.

second transmitter operates on a fre-' of 29.450MHz, and has an average output of 250 milliwatts. This trans-will be commanded to switch on and ' a number of specially equipped ır radio tracking stations. This will ıe to conserve the satellite's batteries as the transmitter puts a heavy load on the batteries.

"Australis Oscar A" is the first amateur radio satellite to carry this type of command system and to carry a transmitter operating the 29MHz band. This band is of particular interest to radio amateurs, as it can be used for international communications. It is hoped that, by studying the signals from the satellite's 29MHz transmitter, more can be learnt about which times of the day and seasons of the year are most suitable for using the 29MHz band for long distance communications.

The telemetry system in the satellite converts data (produced by sensors) such as battery voltage and temperature into audible tones. These tones are then fed to the two transmitters which relay the information to radio amateurs stations on the ground. This telemetry unit is also linked to a keyer, which produces the letters "HI" every 60 seconds.

The satellite carries seven sensors which are fed into the telemetry system. These consist of three horizon sensors, a battery voltage sensor, a battery current drain sensor, a battery temperature sensor and a sensor attached to the inside skin of the satellite. Each sensor is sampled for 7½ seconds. At the end of the seventh tone, two "HI's are sent, and then the whole sequence is repeated.

The command decoder and receiver system in "Australis Oscar A" will receive specially coded signals from a number of amateur radio tracking stations. These signals will be used to switch the 29MHz transmitter on and off, to conserve battery power.

A magnetic attitude stabilisation system (MASS), which consists of a permanent bar magnet and hysteresis rods, will stabilise the satellite. This should reduce the effect of signals fading, as the satellite orbits the earth. "Australis Oscar A" is the first amateur radio satellite to incorporate such a system.

It is hoped that "Australis Oscar A" will orbit the earth at a height of about 500 statute miles, with an inclination to the equator of approximately 70 degrees. This would mean that the satellite would orbit the earth once every 103 minutes and it would complete 15 orbits every 24 hours. Although the radio equipment will operate for about two months, it is expected that the satellite will remain in orbit for 50 to 100 years.

Project Oscar Inc., is a California-based organisation of radio amateurs. They have built four amateur radio satellites since 1961. All of these have been successfully

s and notes of Divisional and Club ties submitted for inclusion in columns should be forwarded to Pierce Healy, 69 Taylor St., Bankstown, N.S.W.

10th Jamboree-on-the-Air

The 1967 Scout Jamboree-on-the-Air, the tenth to be held, has been scheduled for the period 0001 hours GMT on Saturday, August 5th to 2359 hours GMT Sunday, August 6th. This coincides with the holding of the XII World Jamboree in Idaho, U.S.A. and also with the 60th Anniversary of the first experimental Scout Camp on Brownsea Island, England in 1907.

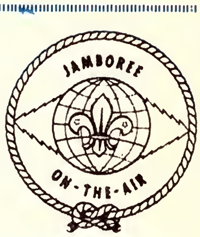
In celebration of Scouting Diamond Jubilee, Scouts throughout the world are planning special camps during this period and it is hoped most, if not all, will be equipped for the weekend of the 5th and 6th August with an amateur station "linking" them with stations both at the World Jamboree and on Brownsea Island.

As in the past no doubt many more members of Scouting groups will be invited by amateur radio operators to participate in the J.O.T.A. from the operators' home stations. The World Bureau Scout station VE3WSB will not operate during this J.O.T.A. Instead, its place will be taken by K7WSJ, operating from the Jamboreee site at Farragut State Park, Idaho, U.S.A.

The station will operate continuously during the 48-hour period of the Jamboree-on-the-Air, using three complete stations. The following frequencies will be used, according to band conditions.

Band	CW	Phone (SSB)
80 metres	3525KHz	3950KHz
40 metres	7025KHz	7290KHz
20 metres	14025KHz	14290KHz
15 metres	21025KHz	21290KHz
10 metres	28025KHz	28590KHz

A special station will operate from Brownsea Island, using the call sign GB3BS1. The originator of the Jamboree-on-the-Air, Les Mitchell, will be in charge of this station. Both stations will issue special QSL cards to all stations they contact.



Official emblem of the Jamboree-on-the-Air.

The following are call signs of Scout-operated amateur stations in Great Britain — GB3BPH and G3TGS in London (Baden Powell House); G3TZR in Liverpool; G3MVH in Halifax; G3RSS in Rastrick; also G3BHK, G2CAJ, G3FXC, G3SDG, G3VNU, G3VQR, G3VHK, G3VJL and G3VKZ.

During the 9th J.O.T.A. held on October 1966, the World Bureau Official Station, VE3WSB recorded contacts with the following Australian call signs: VK6RU, VK5LC, VK5NM, VK3SD, VK2AFY and VK9XI.

In recent years, participation by Australian amateurs has been among the highest in the world, and contacts with Australian stations are eagerly sought after. The event enables many young people to be introduced to amateur radio and has been a means of excellent publicity for the amateur service.

The Wireless Institute of Australia, along with kindred bodies throughout the world, recommends participation by members in the Jamboree-on-the Air. All that is necessary to participate is to contact a local Scout group or District Scoutmaster and either arrange for members of the group to visit your station, or to set up portable equipment at a Scout Hall or camp site. Scouts are very adept at erecting antennas.

The event is not a contest but rather a means of allowing an exchange of greetings between local and overseas Scouting groups by means of amateur radio.

WARBURTON FRANKI

AFTER-STOCKTAKING SPECIALS

KNOBS Attractive white knurled edge. Black face with gold moulded pointer. 1½" diameter. 9/16" deep. Standard ¼" bore in brass bush.

20c ea. or $2.25 doz.
Inc. pack. and post.

MICROPHONE CABLE, TWIN
¼" diameter. Black P.V.C. covered. 100 yard rolls.

$15.75 ea.
inc. pack. and post.

PANEL METERS

MR2-P	SIZE—1¾" Square		
	0-500 Microamps	..	$3.25
	0-1 Milliamp	...	$3.10
	0-300 Volts A.C.	..	$3.10
P25	SIZE—2¾" Square		
	0-1 Milliamp	....	$5.00
CR3-P	SIZE—3" x 3½"		
	0-300 Volts AC	...	$4.85
P60	SIZE—6" x 4½"		
	0-1 Milliamp	......	$8.60

MOVING IRON AC/DC METERS
SIZE—1¾" Square—
$3.50 each.
0-1, 0-5, 0-10, 0-20 amps.
0-10, 0-20, 0-40, 0-50 Volts
ANY OF ABOVE—POST FREE.

HIGH STABILITY RESISTORS
1 Watt ± 1%, 15 ohms to 8.2 megohms
1 Watt ± 2%, 11 megohms to 30 megohms
Famous Rosenthal Brand Made in West Germany.
Write or Call for List of Values Available **25c each.** **Post Free**

SAPPHIRE STYLI ALL TYPES
STEREO L.P. OR STANDARD
Any single Tip ...... **75c each**
Any double Tip ...... **$1.25 each**

DIAMOND STYLI ALL TYPES
STEREO L.P. OR STANDARD
Any Single Tip ...... **$3.25 each**
Any Double Tip ...... **$4.50 each**
(One Diamond)
(One Sapphire)
Post Free.

VALVES
American Sylvania Type 807.
$1.75 each
Post Free

MINIATURE LOW VOLTAGE ELECTROLYTIC CONDENSERS

2 to 100 mfd in 6, 12, 25 and 50 V.W. Bags of 25 assorted.

$3.50
including pack. and post.

AUDIO AMPLIFIER MODULES
4 transistor—1 watt output. High Impedance Input—100,000 ohms. Low Impedance Input—1,000 ohms Output—4, 8 or 16 ohms. Power Source—6 Volts. Gain—70DB. Size of board, 4½" x 2" approx. Weight: 6 ozs. Supplied with circuit and wiring instructions.
$8.50
inc. postage.

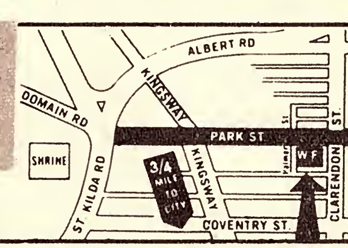
WORLD FAMOUS POLYPACS
No. 1—30 carbon resistors, asst. watt and 1 watt, prese too. **$1.**
No. 2—20 asst. capacitors, 5 eac paper, plastic, mic ceramic. **$1.**
No. 3—20 silver mica capacitor inc. 5 per cent values. **$1.**
No. 5—100 assorted rubber gron mets. **$1.**
No. 6—35 assorted ½ watt resisto (English Erie). **$1.**
No. 7—25 assorted 1 watt resisto (English Erie). **$1.**
No. 8—50 assorted component including resistors, mic condensers, tubular conde sers, styroseal condenser grommets, transistor tran former and potentiomete **$1.**
Guaranteed A1 quality. Popul brands. 1 pack postage, 4c. 3 pack post free.

MONDO 6 TRANSISTOR TAPE RECORDERS MODEL MH-6A
Featuring—Automatic Level Co trol and simple Push Button Oper tion. Will take up to 5" reels. speeds 3¾ and 1⅞ I.P.S. Capsta Drive. Microphone has remote co trol switch. Twin track.
$55.00
Freight Free.

NEW POWER SUPPLY BASIC KIT
Consists of:
One Transformer tapped for 9 and 12V at 500 m.a.
One full wave contact cooled Rect fier.
One 1000mfd 15 V.W. Capacitor.
Make your own 9 or 12 Volt powe pack to supply transistor radio record players, slot cars, toys, et . . . Supplied with wiring diagram
$3.00
Inc. postage.

WARBURTON FRANKI

220 PARK ST., STH. MELB., VIC. Ph. 69-0151 (30 lines)



• **PLEASE INCLUDE POSTAGE OR FREIGHT WITH ALL ORDERS.** • **OPEN SAT. MORNINGS**

:hed into orbit. Oscar I and II were
ons which relayed temperature data to
. Oscar III and IV were fitted with
iunications repeaters which were used
dio amateurs to relay morse and voice
ages across the Atlantic and Pacific
is.

; "Australis Oscar" project team have
in close contact with Project Oscar
during the construction of the Aus-
n satellite. Project Oscar Inc. has
1 to negotiate with United States
hing authorities for a ride into orbit
the "Australis Oscar A" satellite.
was not known at the time of prepar-
iese notes when the launching is likely
e place. When this information comes
ind, details will be given over all
1 Wireless Institute stations and local
services.

ject Australis gratefully aknowledges
ind assistance of the following organ-
is, without whose help the construction
e satellite would not have been pos-

ne Engineering, Melbourne (radio
ency connectors) — Cannon Electric
) Ltd., East Brighton, Melbourne (re-
; and connectors) — Ducon Conden-
'ty. Ltd., Villawood, N.S.W. (all cap-
s used in the satellite) — Fairchild
ilia Pty. Ltd., Croydon, Melbourne,
ransistors and diodes used in the
e) — The Potter Foundation,
iurne (travel grants to Project Oscar
n the U.S.A. for two persons)—Pye
Ltd., Melbourne (all radio frequency
ls used in the satellite). — Rola Co.
) Pty. Ltd., Melbourne (magnetic atti-
stabilisation system magnet)—Sample
onics, Melbourne (circuit boards) —
r Industries Ltd., Melbourne (satellite
nae)—Union Carbide Australia Ltd.,
y (flight and backup battery packs). —
y Components Division also gave a
grant for a third person to accom-
he satellite to the United States.

nks are also extended to the Meteoro-
Department of the University of Mel-
e and the Bureau of Meteorology,
ourne, who have been most helpful
he past 15 months.

.G.B. DX Contest Result

: results of the Fifth R.S.G.B. 7MHz
contest held late last year do not
a great interest on the part of
urs in Oceania. In the CW section
logs were submitted by Australian
is, while in the telephony section
one call sign appeared.

the CW receiving section of the con-
ie first and third places were taken
ustralian Short Wave Listeners. The
r of the CW section was — A. J.
G3FXB 3447 points. Australian station
ons were:—

P. J. Dettman VK3APJ 850 points
I. E. De Cure VK5KO 700 points
I. Stafford VK3XB 400 points

al logs received — 138.

the telephony section the winner was:
ibson G13OQR 2997 points

a total of 37 logs submitted, last
on was occupied by: I. Stafford
XB 200 points.

the CW receiving section:
orge Allen, West. Australia, 1740 points.
: Tribilcock, Victoria, 1300 points.

1967 R.S.G.B. 7MHz contests are set
for Telephony Section, 28th-29th Oc-
Telegraphy Section 11th-12th No-
er.

es for the contest will be given in the
er issue of these notes.

21MHz and 28MHz Contest

1967 21MHz and 28MHz R.S.G.B.
iony contest will be held on the 14th
5th October. Rules for this contest
ppear in the September issue of these
With conditions improving on these
there is reason to anticipate some very
contacts during the contest.

WIRELESS INSTITUTE ACTIVITIES

A booklet entitled "How to Become a Radio Amateur" is being prepared by the Federal Executive of the Wireless Institute of Australia. This will give the person who desires to obtain an amateur operator's licence, all the details on the assistance the Institute can offer the prospective amateur. It will also answer many questions about amateur radio including those generally asked by those preparing themselves for the required P.M.G. examination.

Copies of the booklet may be obtained by writing to the Federal Secretary, Wireless Institute of Australia, Box 2611W, G.P.O., Melbourne.

NEW SOUTH WALES

The council of the New South Wales Division has instituted a membership drive. The aim is to extend to amateurs living within the State who are not already members, an invitation to join the institute. Already more than 50 per cent of the licensed amateurs are members and it has been suggested that each member should endeavour to obtain one new member.

An increase in membership will allow an increase in the services and facilities available to members. Details of membership fees and other information can be obtained by writing to the Secretary, N.S.W. Division W.I.A., 14 Atchison St, Crows Nest.

Hunter Branch

The lecturer at the May meeting of the Hunter Branch was Lionel Dooland, VK2ZLD, well known as a lecturer of Electronics at the Newcastle Technical College. He chose to speak about "Professionalising Amateur Equipment" and his lecture was a very practical one which outlined the various methods of metal treatment and construction.

In addition, he showed several completed items of equipment which employed the techniques described. One of the largest audiences in recent years, 50 members and visitors, attended the lecture. As has become the policy, the meeting commenced with a colour film. The topic on this occasion concerned the manufacture and use of printed circuits.

The July meeting which is to be held in Room 6 of the Clegg Building, Newcastle Technical College, will be addressed by Gordon Sutherland, VK2ZSG, who has the reputation for reworking the popular "Command" series receivers, will outline his most popular conversions, including one for double conversion to improve selectivity.

The meeting, which commences at 8 p.m. will feature a film of interest to amateurs and short wave listeners. The Hunter Branch President, Frank Boundy, VK2ZFX, extends a welcome to all radio enthusiasts in the Newcastle area to be present at this and any Hunter Branch meetings. The meetings are held regularly throughout the year on the first Friday of each month.

Several Newcastle amateurs were hosts during May to Nubuo Matsukura who as JA3API/MM is well known to operators on the 80 and 40-metre bands. Nubuo was making a short visit to the city while his ship London Maru was in port. The amateur station operated by Nubuo has a power input of 25 watts to a long wire antenna and has tallied up the impressive total of 188 countries while mobile marine. He usually operates on 3550KHz between 0800 and 1200 hours GMT while in Australian waters.

Iuswellbrook Amateur Radio Club

: inaugural meeting of the Muswell- Amateur Radio Club was held on May 67. This club, which is affiliated with N.S.W. Division, will serve amateurs ntending amateurs in the Upper Hunter :ts.

fficers elected were:

sident: Ken Mitchelhill, VK2ANU.
e-president: Les Baber, VK2RJ.
retary: P. J. Charlton.
asurer: H. Ewen.
nmittee: K. Miller, J. Woods, J. Tim- N. Cameron.

QUEENSLAND

: Townsville Amateur Radio Club meet- ıre held on the first Thursday of each ı at 8 p.m., in the Auditorium of Station 4TO, Townsville. At Iay meeting, members discussed the ıility of participating in the "Australis" te project. From the enthusiasm shown ms certain that the Club will be sup- g such a scheme.

ce Noseda, VK4ZMI, has been elected l Class Instructor and now has two ; under instruction. These are held on lays at the 4TO auditorium. Elemen- :lasses are held from 8.30 a.m. to 10 ınd advanced classes from 10 a.m. to a.m.

SOUTH AUSTRALIA

May issue of the South Australian ɔn's journal contains some interesting on the use of FET transistors. Writ- Rick Matthews, VK5ZFQ, the article information on the use of these de- in VHF convertors. The journal ulated to all financial members of the n. An invitation is extended :nsed amateur operators, who are not y members to join the division. Appli- ; for membership should be made to :cretary, W.I.A., South Australian Divi- Box 1234K, G.P.O., Adelaide.

WESTERN AUSTRALIA

the Annual General Meeting of the n Australian Division, held in April, allot for the 1967-1968 council was The office bearers for the ensuing re:

on: W. G. Hayman, VK6GH.
ident: R. Chamberlain, VK6RY.
-President and Technical Officer: V. ıey, VK6VK.
-President and Bulletin Editor: W. G. VK6WY.
etary and Federal Contest Manager: Penfold, VK6ZDK.
ısurer: K. Moore, VK6ZBT.
ıdcast Officer: R. Elms, VK6BE.
th Club Co-ordinator: Rev. Bro. J. n, VK6RT.
.F. Officer: L. Jessop, VK6ZEA.
;ram Organiser: G. Sturcke,VK6ZEZ.
Officer: J. Rumble, VK6RU.
:tin Distributor and "A.R." Sub- R. Greenway, VK6DA.

he annual report the retiring presi- '. Kitney, VK6VK, referred to the ing membership of the division, the level of attendance at general ;s and the need to give serious con- ion to the formation of a Region III :nce.

W.A. VHF Group

teur television test transmissions were d to be taking place on the 432MHz in Perth and to assist those who to receive these signals, the details construction of a 432MHz convertor :n published in the May issue of the roup bulletin. The convertor is to be ıead of a standard TV receiver and pproximately $3 to build. Two type ; or 2N3564 transistors are used.

group's club station operates beacon tters on 52.006MHz and 144.198MHz ously with automatic CW identifica- ll sign VK6VF, with approximately d key-down position between call

bers of the group meet on the fourth y in each month in the D.C.A. Work- nteen, 86 Guildford Road, Maylands, m. Visitors are welcome to attend.

R.S.G.B. NEWS

The editorial in the April edition of the Radio Society of Great Britain bulletin draws the attention of British amateurs to the Wireless Telegraphy Bill published at the beginning of March. It is pointed out that the sweeping blanket powers conferred on the Postmaster-General by Part II of the Bill, if passed by the British Parliament in its present form and placed on the Statute Book, could place the very existence of amateur radio in jeopardy.

"The heading of Part II is innocuous enough — 'Miscellaneous' — but the side heading should give the red light — 'restrictions of manufacture or importation of certain apparatus.' Under section 7. (1) and (2) of the Bill if the PMG 'specifies' apparatus, no person shall manufacture, whether or not for sale, any apparatus of that class or description; and the importation of apparatus of that class or description is prohibited.

"The only limitation placed on the powers of the P.M.G. to specify equipment is that it must be related to 'interference,' which could be extended logically to include any form of receiving, test or transmitting equipment containing an oscillator. It will be seen that not only may one not buy 'specified apparatus' but also it may not be built, so that by carrying the possibilities to their full limit you could be in serious trouble by constructing a grid dip oscillator.

"It will, of course, be said that the P.M.G. would never use his sweeping powers to prohibit amateur equipment, but what P.M.G. would consider himself bound by the words of his predecessor in another government. Many reasons could be found for a change of policy. No, this is not the answer, which lies in a nation wide effort to prevent this Bill from becoming law in its present form.

"Have our friends who advertise in the pages of the 'Bulletin' considered the possible effect on their trade if this consists mainly of selling components to the thousands of constructors throughout the country Restrictions in the types of equipment which may be built in the home workshop — note the words — whether or not for sale — could put them out of business."

Other comments refer to the power to prohibit importation of wireless apparatus as presumably designed to restrict the flood of walkie-talkies which are now causing interference to television receivers. Members of the R.S.G.B. are also urged to record their disapproval of the Bill in its present form, to their Members of Parliament.

I.T.U. NEWS

The 22nd session of the Administrative Council of the International Telecommunication Union opened on Saturday May 6th at the I.T.U. Headquarters in Geneva, Switzerland. The session continued until May 27th. The Council consists of the representatives of 29 countries, who were elected from among the members of the Union at the Plenipotentiary Conference held in Montreux, Switzerland, in 1965. These countries are as follows.

Region A (Americas): Argentine Republic; United States of America; Canada; Mexico; Republic of Venezuela; Brazil.

Region B (West. Europe): France; Italy; Confederation of Switzerland; Federal Republic of Germany; United Kingdom of Great Britain and Northern Ireland; the Channel Islands and the Isle of Man; Ireland.

Region C (East Europe and North Asia): Union of Soviet Socialist Republics; Federal Socialist Republic of Yugoslavia; Peoples Republic of Poland.

Region D (Africa): Kingdom of Morocco; Republic of Dahomey; Federal Republic of Nigeria; Algerian Democratic and Popular Republic; Ethiopia; Malagasy Republic; Uganda.

Region E (Asia and Australasia): Japan; Commonwealth of Australia; Republic of India; Pakistan; Lebanon; Kingdom of Saudi Arabia; China.

At its first Plenary meeting the Council elected as chairman Mr Proinnsias L. O. Colmain (Ireland), who had been vice-chairman of the 21st session in 1966, and Mr Henryk Baczko (People's Republic of

Poland) as vice-chairman. It also ap chairmen and vice-chairmen for th committees (Finance, Staff, Technic operation).

The meeting was opened by Mr Rutschi (Switzerland), chairman of t session. Mr Rutschi, welcoming th gates of the 29 member countries Administrative Council, recalled t event of 19th February 1967, when D Sarwate, Secretary-General of the died. He invited the meeting to ob one-minute silence in memory of I wate. He also recalled how Mr Moh Mili (Tunisia), Deputy Secretary-C had taken over the duties of Se General ad interim, in accordance w International Telecommunication C tion (Montreux 1965).

Mr P. L. O. Colmain, the new ch of the Administrative Council, then t the meeting for the honour confer his country and himself by his elec such important duties. After review program of work facing the present he invited the council to pay tribute memory of former participants who h since the previous council session. Baczko, the new Vice-chairman, thanked the Council.

Mr Mili, Secretary-General ad int the I.T.U. welcomed the members Council and reviewed the various adm tive and technical problems raised by activities. He emphasised that "as it e on this second century of its ex there is no doubt that the two mai lems facing the I.T.U. are those c nical co-operation and space teleco cation."

VHF DX ACTIVITY

Two letters giving some most int details of the VHF band conditi northern Australia have been r Writing at the beginning of May Lindsay, VK4ZPL, of Townsville, land, stated:—

"As the Australian Sporadic E, DX faded in February, the 52MH opened to the north and has bee every day since. While I expecte northern openings to last only un April, it is now well into May a openings are just as strong and co

"The variety of stations that received at this location is amazi sound stations can be heard between and 49.5MHz. Meteor scatter stations between 49.5MHz and 50MHz. J and JH stations operate between and 52MHz, with by far the number operating within the first of the band. In addition in this section JA radio-telephone services a IGY stations can be heard.

"JA stations have been heard as 52.7MHz trying to contact Au stations. In the Australian six met 52MHz — 54MHz, Chinese AM may be heard usually between 53M 53.4MHz. Some evenings jamming can be heard.

"Needless to say the three local six-metre stations VK4ZRG, VK4Z VK4ZPL have each worked all areas many times over. Recently t KA station was heard and worke KA7AB, can only hear VK stations first 100KHz of the Australian ban transmits SSB in the first 100KHz 50MHz band. More KA stations on the air shortly.

"Russian TV pictures have been in Townsville during April, similarl channel 0 pictures have been rece Japan."

Michael Richardson, VK8ZMR, Darwin, Northern Territory writes:—

". . . a note to provide some information regarding the tremendo DX success to the north. Dou Arthur, VK8KK, Alice Springs ha working openings to Japan since to late February 1967.

"Barry Burns, VK8DI, Darwin ha ed about 90 JA and JH stations wh included all JA call areas and J April 1, he worked KR6TAB."

Referring to his own achiev Michael wrote: "Worked first break

JOHN MOYLE MEMORIAL — RESULTS

results of the 1967 John Moyle ›rial National Field Day Contest ›ver the weekend February 11th-12th that the contest still retains its ırity and although the entry list was the activity among the field stations ommendable. The multi-operator sta- having a large number of operators ›ility to operate on many bands, pro- some high scores.

ılts:

SIX HOUR DIVISION

ı (a) Portable/Mobile Transmitting Phone

ign	Score	Contacts
S/P	398	53
WW/P	518	79
J/P	109	11
C/P	186	24
)/P	101	11
Z/P	89	11

ı (b) Portable/Mobile Transmitting C.W.

Sign	Score	Contacts
B/P	133	22
GI/P	104	15
A/P	97	17

ı (c) Portable/Mobile Transmitting Open

E/P	155	23
U/P	19	4

(d) Portable/Mobile Transmitting Multiple Operator.

ign	Score	Contacts
S/P	507	79
/P	369	53
Z/P	608	71

(e) Fixed Transmitting station work- ›rtable/Mobile stations—Open only.

gn	Score	Contacts
V	200	16
Z	140	11
	115	8
M	435	29

Section (f) Reception of Portable/Mobile Stations

S.W.L. No.	Score	Stations Heard
WIA-L4144	390	26
WIA-L4205	280	19
WIA-L4182	165	11

24 HOUR DIVISION

Section (a) Portable/Mobile Transmitting Phone

Call Sign	Score	Contacts
VK1VP/P	90	8
VK3WK/P	752	112

Section (b) Portable/Mobile Transmitting C.W.

Nil Entries.

Section (c) Portable/Mobile Transmitting Open

Call Sign	Score	Contacts
VK5ZF/P	561	64

Section (d) Portable/Mobile Multi-operator Open only

Call Sign	Score	Contacts
VK2AAH/P	3786	682
VK3RN/P	2621	467
VK3VK/P	1432	247
VK3ANU/P	1265	222
VK5LZ/P	2094	286
VK6VF/P	230	30
VK9XI/P	1019	175

Section (e) Fixed Transmitting Stations working Portable/Mobile Sations, Open only.

Call Sign	Score	Contacts
VK1DA	215	14
VK2AEC	300	22
VK3XB	665	53
VK3ANG	475	41
VK3KS	245	20
VK3GK	103	13

Section (f) Reception of Portable/Mobile Stations.

S.W.L. No.	Score	Stations Heard
WIA-L2022	450	36
WIA-L2023	230	19
P. Forbes	770	59
WIA-L3042	555	45
J. Ross	645	47
WIA-L5065	435	31

rwin on March 4, 1967. Since then orked over 130 different JA and JH ns and logged over 170 JA and JH on six metres.

› worked KR6TAB, Al Edwards on 'a, the first contact being on May 13, nce then have had another three s. JH2HMO, who at the time was ; a power input of 2 watts to the 'as also contacted. Also conditions ›en recorded when JA stations run- power input of 20 watts have been ım signal strength."

VK8DI, Michael has worked all e call areas and JH1 on the six ›and.

›uth Radio Scheme

ıeeting of Youth Radio Scheme el was scheduled to be held in on Saturday, June 3. Matters to administration, age limits, regis- and expansion of the scheme were l on the agenda. Interstate repre- es were also expected to be in ıce. A report will be given in the ıe of these notes.

nagazine committees of the Victorian ı of the Y.R.S. and the Short Wave s group have joined together to a composite magazine called "Zero- Copies of the magazine will be sent members every two months. The magazine will contain news of Y.R.S. and S.W.L. activities as well as circuits and description of equipment of interest to both groups.

The official club station of the Victorian Division Youth Radio Scheme, VK3ANE, transmits a morse practice session every Wednesday evening, commencing at 7 p.m. in the 3.5MHz band for a period of twenty minutes.

This service is designed to assist students to achieve the speed necessary for them to qualify for the Junior Radio Certificate and higher.

The station operator is Don Reid, VK3EI, who is pleased to receive reports from club stations and listeners.

CANBERRA YOUTH RADIO CLUB

Meetings of the club are held in the Tearoom, 8th Floor, M.L.C. Building, Civic, every Saturday night from 6.30 p.m. to 8.30 p.m. The meetings are divided into sessions, the first is the elementary class followed by the junior class. Further details of the club may be obtained by either attending a meeting or writing to — Roger Davis, VK1RD, 14 Hovea Street, O'Connor.

Copies of the "Postal Group Bulletin" which contains useful technical information for Y.R.S. club leaders and members is available from Roger Davis VK1RD. Applications for the bulletin should be accompanied by a self-addressed stamped envelope together with eight cents to cover publication costs.

foster®

■ dynamic microphones

*MDF-600B cardioid microphone

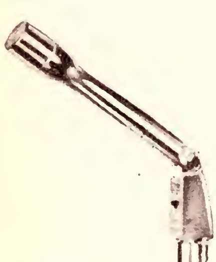
SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 100~10,000 c/s±8 dB
†Sensitivity : −52 dB±3 dB,
Dimensions : 148×48×34.5 mm without stand
Cable : 4 ϕmm, 3 m
Weight : 1¼ lbs (525 g)

DF-1DE

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 150~10,000 c/s±8 dB
†Sensitivity : −57 dB±3 dB,
Dimensions : 385.5 mm high
21 mm diameter, microphone
128 mm diameter, stand
Cable : 4 ϕmm, 1.5 m
Weight : 1⅚ lbs (840 g) with cable

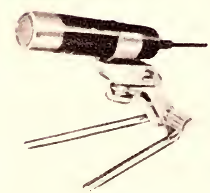
*DF-14B

SPECIFICATIONS
Impedance : 50 kΩ Variable
Frequency Response : 100~10,000 c/s±8 dB
†Sensitivity : −48 dB±3 dB,
Dimensions : 136×75×47 mm
Cable : 6 ϕmm, 4 m
Weight : 2 lbs (900 g)



*DF-22B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 50~12,000 c/s±7 dB
†Sensitivity : —57 dB±3 dB,
Dimensions : 32.5 mm diameter, 220 mm long
Cable : 6 ϕmm, 4 m
Weight : 1¼ lbs (575 g)

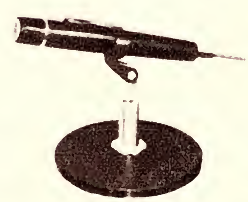


DF-1/*DF-1B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 100~10,000 c/s
†Sensitivity : —57 dB±3 dB,
Dimensions : 21 mm diameter, 82.7 mr
Cable : 3 ϕmm, 1.5 m
Weight : 3.9 oz (110 g) with cable

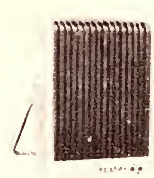
DF-3

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 50~12,000 c/s±
†Sensitivity : −56 dB±3 dB,
Dimensions : 33.5 mm diameter, 133 n
Cable : 4 ϕmm, 1.5 m
Weight : 9.0 oz (255 g) with cable



DF-12/*DF-12B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 80~12,000 c/s±
†Sensitivity : −57 dB±3 dB,
Dimensions : 23 mm diameter, 158 mm
Cable : 3 ϕmm, 1.5 m
Weight : 6.3 oz (180 g) with cable



*DF-2B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 100~10,000 c/s±
†Sensitivity : −56 dB±3 dB,
Dimensions : 75×53×30 mm
Cable : 3 ϕmm, 1.5 m
Weight : 4.8 oz (136 g) with cable

*DF-51B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 150~8,000 c/s±
†Sensitivity : −57 dB±3 dB,
Dimensions : 98×58×36 mm
Cable : 6 ϕmm, 1.6 m, Coiled
Weight : 7.3 oz (207 g) with cable

* with switch : † at 1,000 c/s, 0 dB=1 V/μ bar

(SOLE AGENT) **ZEPHYR PRODUCTS PTY. LTD.**
70 BATESFORD ROAD, CHADSTONE, VICTORIA—PHONE 56-7231
MANUFACTURERS OF RADIO & ELECTRICAL EQUIPMENT & COMPONENTS

1967 W.I.A. REMEMBRANCE DAY CONTEST

1967 Remembrance Day Contest will be cted under the new set of rules proposed il Mitchell VK3UM, and adopted by the al Council of the Institute at the 1966 il Convention held in Brisbane. The period en the ratification of the decision of Federal il by divisions of the institute and the set down for the contest did not allow ederal Contest Comittee time to publish new rules applying. In accordance with ite policy relating to such contests.

› major changes in the contest relate to:

e formula used to determine the score of ch division:

trastate scoring for all bands above 52MHz us allowing the scores of limited licensees be included in the total points of a vision.

contest is held in memory of Australian urs who paid the supreme sacrifice during War II. A perpetual trophy is awarded ly for competition between the six divisions Institute. It is inscribed with the names ose members and so perpetuates their y throughout amateur radio in Australia. name of the winning division each year inscribed on the trophy and in addition, winning division will receive a suitably ed certificate.

ECTS: Amateurs in each Call Area, Includ- ustralian Mandated Territories and Aus- Antarctica will endeavour to contact rs in other call areas on all bands. urs may endeavour to contact any other r on the authorised bands above 52MHz ntrastate contacts will be permitted in IF/UHF bands for scoring purposes).

ITEST DATE: 0800 hours GMT Saturday, 12, 1967 to 0759 hours GMT Sunday, 13, 1967.

amateur stations are requested to observe nutes' silence before the commencement of ntest on Saturday afternoon. An appro- broadcast will be relayed from all divisional s during this period.

ES:

here shall be four sections to the contest:
(a) Transmitting Phone.
(b) Transmitting CW.
(c) Transmitting open.
(d) Receiving open.

ll Australian amateurs may enter the whether their stations are fixed, portable bile. Members and non-members of the s Institute of Australia will be eligible ards.

ll authorised amateur bands may be used oss-mode operation is permitted. Cross- peration in not permitted.

mateurs may operate on both Phone and uring the contest, i.e., phone to phone, CW, or phone to CW. However only try may be submitted for sections (a) to rule 1.

open log will be one in which points aimed for both phone and CW trans- s. Refer to rule 11 concerning log entries.

or scoring only one contact per station nd is allowed. However, a second scoring can be made on the same band using ternative mode. Arranged schedules for s on the other bands are prohibited.

ulti-operator stations are not permitted. h log keepers are permitted, only the operator is allowed to make contact his own call sign. Should two or more operate any particular station, each will sidered a contestant and must submit a log under his own call sign. Such con- shall be referred to as "substitute s," for the purpose of these rules and erating procedure must be as follows:

e: Substitute operators will call "CQ RD" Remembrance Day," followed by the call the station they are operating, then the "log" followed by their own call sign, Q Remembrance Day from VK4BBB log A.

Substitute operators will call "CQ RD de" by the group call sign comprising the n of the station they are operating, an stroke and their own call sign, e.g., de VK4BBB/VK4BAA."

stants receiving signals from a substitute will qualify for points by recording sign of the substitute operator only.

trants must operate within the terms of ences.

PHERS: Before points may be claimed ontact, serial numbers must be exchanged nowledged. The serial number of five or res will be made up of the RS (tele- or RST (CW) reports plus three figures, ll increase in value by one for each e contact. contestant reaches 999 he will start th 001.

tries must be set out as shown in the using only one side of the paper and possible standard W.I.A. log sheets be used. Entries must be clearly marked mbrance Day Contest 1967," and must marked not later than September 4, 1967. entries to: Federal Contest Manager, G.P.O. Box N1002, Perth, Western a. Late entries will be disqualified.

a) Interstate scoring is as per published r all bands, 52MHz and above included. Intrastate scoring for all bands above will be on the basis of one point per Portable Operation: Long scores of opera- rking outside their own call areas will ted to that call area in which operation ace, e.g., VK5ZP/2. His score counts to- ew South Wales total points score.

ll logs shall be set out as in example

SCORING TABLE

To	VK0	VK1-2	VK3	VK4	VK5-8	VK6	VK7	VK9
From VK0	-	6	6	6	6	6	6	6
" VK1-2	6	-	1	2	3	5	4	6
" VK3	6	1	-	3	2	5	4	6
" VK4	6	1	2	-	3	6	5	4
" VK5-8	6	2	1	3	-	5	4	6
" VK6	6	1	2	4	3	-	5	6
" VK7	6	2	1	4	3	5	-	6
" VK9	6	1	2	3	4	5	6	-

NOTE: Read table from left to right for points for the various call areas.

EXAMPLE OF TRANSMITTING LOG

DATE / TIME G.M.T.	BAND	EMISSION AND POWER	CALL SIGN WORKED	RST No. SENT	RST. No. REC'D.	POINTS CLAIMED

EXAMPLE OF RECEIVING LOG (VICTORIA S.W.L.)

DATE / TIME G.M.T.	BAND	EMISSION	CALL SIGN HEARD	RST No. SENT	STATION CALL	POINTS CLAIMED
Aug. 1967						
12 0810	7MHz	A3(a)	VK5PS	58002	VK6RU	2
12 0812	7MHz	A3(a)	VK6RU	59007	VK7EJ	5
12 1035	52MHz	A3	VK4ZAZ	56010	VK5ZDR	3
12 1040	52MHz	A3	VK3ALZ	59025	VK3QV	1

shown, in addition will carry a front sheet showing the following information.

Name .... Section ......
Address .... Call Sign .....
Claimed Score ....
No. of Contacts ....

Declaration: I hereby certify that I have operated in accordance with the rules and spirit of the contest.

Signed ....
Date ....

All contacts made during the contest must be shown in the log submitted (see rule 4). If an invalid contact is made it must be shown but no score claimed.

Entrants in the Open Section must show CW. and phone contacts in numerical sequence.

12. The Federal Contest Manager has the right to disqualify any entrant, who, during the contest, has not observed the regulations or who has consistently departed from the accepted code of operating ethics. The Federal Contest Manager also has the right to disallow any illegible, incomplete or incorrectly set-out logs.

13. The ruling of the Federal Contest Manager of the Wireless Institute of Australia is final and no disputes will be discussed.

AWARDS: Certificates will be awarded to the three top scoring stations in each of sections (a) to (c) of rule 1 above, in each call area, and will include top scorer in each section of each call area, operating exclusively on 52MHz and above. VK1, VK8, VK9 and VK0 will count as separate areas for awards. There will be no outright winner for Australia. Further certificates may be awarded at the discretion of the Federal Contest Manager.

The division to which the trophy will be awarded shall be determined in the following way:

By using the equation,

$$S = \frac{P + 175(N - E)}{1000}$$

where S = States Trophy Tally Points
where P = Total score of State
where N = Total log entries received
where E = Entrants from State concerned.

VK1 scores will not be included with VK2 nor VK8 with VK5.

The trophy shall be forwarded to the winning division in its container and will be held by that division for the specified period.

RECEIVING SECTION
(Section D)

1. This section is open to all Short Wave Listeners in Australia, but no active transmitting station may enter.

2. Contest times and logging of stations on each band are as for transmitting.

3. All logs shall be set out as shown in the example. The scoring table to be used is the same as that used for transmitting entrants and points must be claimed on the basis of the State in which the receiving station is located. A sample to clarify the position is shown above.

It is not sufficient to log a station calling "CQ" — the number he passes in a contact must be logged.

It is not permissible to log a station in the same call area as the receiving station on the M.F. and H.F. bands 1.8MHz to 30MHz, but on bands 52MHz and above such stations may be logged, once only per band, for one point. VK1/VK2 and VK5/VK8 are considered to be the same area for scoring purposes.

4. A station heard may be logged once on phone and once on CW for each band.

5. Club receiving stations may enter for the Receiving Section of the contest, but will not be eligible for the single operator award. However, if sufficient entries are received a special award may be given to the top receiving station in Australia. All operators must sign the declaration

AWARDS: Certificates will be awarded to the highest scorers in each call area. Further certificates may be awarded at the discretion of the Federal Contest Manager.

New Electrolytic Condensers

These condensers are miniature pigtail type insulated new stock in packets of 12, each packet containing; 3, 16mfd 300V.W., 2-32 mfd. 300V.W., 1 25mfd. 450 V.W. and 6 low voltage electrolytics. **$2.50.**

Post and packing 20c extra.

NEW IMPORTED 4" P.M. SPEAKERS

Available with a 4 or 16 ohm voice coil. **$2.50.**
Post and packing 30c extra.

NEW IMPORTED SLOT CAR KITS A

LESS THAN HALF PRI

Complete kit of parts including motor and full instructions.

$2.50 post 25c

Imported National Transistorised Shoulder Megaphone

These shoulder megaphones manufactured by National Radio Japan have an output of 4 watts, and are supplied complete with inbuilt horn type speaker, batteries and microphone. List price $78.

Special Price $50. Post extra
Other types also available.

NEW AMERICAN T
TELESCOPE TV AERI
Extends to 36in, each se can be used singly for ca portable .. **$1.50.** Post

SINGLE TELESCOPI
Aerial 12in extends to 60 cents. Post 10 c

NEW 4-SPEED STEREO PLAYER F.O.R. .. $17.50 (£8/15/)	**NEW STEREO CHANGER. 4-SPEED F.O.R. .. $21.50 (£10/15/)**	**SLIDER-SWITCHES 10 pole 2-way silver plated contacts**

POWER TRANSFORMER

Prim. 240V Sec. 350 volts a side. 60 M.A. One 6.3V, one 5V F11.

$2.75 Post N.S.W. 60c, Interstate 80c.

LEADER SIGNAL GENERATOR LS

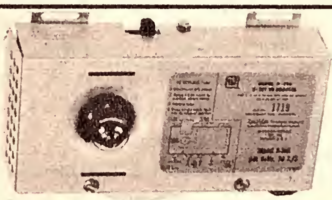
240V A.C. operated, 6 band 120KC to 390
Provision for crystal.
Post N.S.W., 75c; Interstate, $1.25. **$29**

BATTERY CHARGER RECTIFIERS

New Selenium Rectifiers, 6 or 12 volt at 4 amp., $3.75. Post, N.S.W., 20c; Interstate, 20c. Transformer for above rectifier tapped for 6 to 12 volt, with circuit for charger, $4.75. Post, N.S.W., 75c; Interstate $1.00.
As above, 6 or 12 volt, at 2 amp., $2.75. Post, N.S.W., 35c; Interstate, 45c. Transformer for above, $3.75. Post, N.S.W., 35c; Interstate, 45c.

NEW 240V. A.C. MOTORS

These small motors, size 5in x 3in x 3½in, are 1-12 h but are only suitable for intermittent use. $2.95. N.S.W. 35c; Interstate 50c.



$9.75 (£4/17/6) POST FREE

NEW AMERICAN TV POWER BOOSTER UNIT AT LESS THAN HALF PRICE

(EX LIQUIDATION STOCK H. G. PALMER)

These TV POW-R boosters can be used in two ways. Firstly as a "straight-t circuit giving extra boost to the TV signal for improved performance on receiver.
Secondly to boost signal strength to two or three TV receivers coupled to one aerial.

Full instructions supplied with each unit. 240 volt A.C. operation.

THE NEW COLLARO 3-SPEED 4 TRACK TAPE-DECKS

$48.00

The ideal deck for the home constructor, as amplifier and all controls can be mounted on deck.

• 3-speed 1⅞, 3¼, 7½. • Pause control. • Takes 7in. spools. • Simplified controls, 4 Tracks, $48; OSC Coils, $1.50.

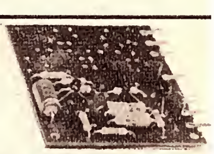
NEW 4" EXTENSION SPEAKERS

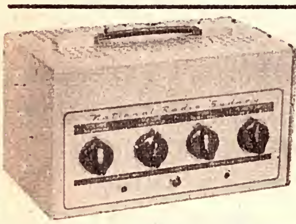
These 4" speakers are mounted in polished cabinets suitable for use as intercom, units or extension speakers.
LIST PRICE $12
SPECIAL PURCHASE ENABLES US TO SELL THESE UNITS AT $4.
Post and packing, N.S.W., 68c. Interstate, 98c.

A PREAMP FOR MAGNETIC PICK-UP OR TAPE HEADS

SUITABLE FOR USE WITH THE COLLARO OR B.S.R. TAPE DECKS

Using 3 silicon transistors as featured in October Electronics Australia complete with kit of parts including transistors mono **$7.50,** stereo **$13.00,** 240 power supply for above **$7.00.**
Please specify if required for pick-up or tape heads.





25 WATT .. $53.75, £26/17/6
17 WATT .. $43.75, £21/17/6
Post Extra on 15 Watt. N.S.W., 10/; Interstate, 15/. 25 Watt by Rail or Air. Too Heavy for Post.

NEW 17 & 25 WATT P.A. AMPLIFIER

The 25 Watt Amplifier uses 5 valves plus 2 rectifiers including two EF86 low noise valves microphone preamplifier and two EL34 valves Ferguson push-pull output.

All amplifiers are fitted with Ferguson output transformers with voice coil tappings of 2 to ohms. The 25 watt amplifier can be supplied with line output transformers tapped from to 600 ohms if required at $2.00 extra.

Inputs provided for microphones. pick-up, and radio with mixing facilties and tone cont

The 15 watt is as above but using two 6BQ5 valves in push-pull output.

12in speaker for above (10 watt) .. .. **$6.75 .. 6**
Crystal Microphones for amplifier .. .. **$4.75 .. 4**

NATIONAL RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE 56-7398.

LISTENING AROUND THE WORI

Art Cushen's monthly report on long-distance short-wave, television and broadcast band reception.

Deutsche Welle Relay on El Salvador

Radio Deutsche Welle, the Voice of Germany, at Cologne, has announced plans for building of a relay base in El Salvador, to cover North and South American areas.

Some months ago, Deutsche Welle announced that they would establish relay bases in Central America and Southern Europe in addition to the Kigali relay in Rwanda, Central Africa, which began broadcasting in 1965. The new Salvador relay base will have two transmitters of 250KW and one of 150KW, while another transmitter of 100KW will carry programs on medium wave. The Kigali station with its 250KW transmitters is well received on its several frequencies in the Pacific area. The station was commenced in June, 1964, at Kigali and 18 months later it began relays of the Cologne programs for reception in Africa.

The Voice of Germany, Deutsche Welle, has been in operation more than 10 years. It has become firmly established with short wave listeners, and signals are beamed to all areas of the world. The Deutsche Welle has its studios in Cologne, and the transmitters are at Julich, about 38 miles from Cologne, near the Belgian frontier. The station has 28 masts (the tallest of them rising to about 300 feet) to carry the transmitter aerials for all the short wave frequency bands. Beams can be switched in opposite directions by push-button controls. Six 100KW transmitters feed the aerial system. Emergency transmitters of 20KW are also provided at the site. At present the Deutsche Welle is broadcasting in 14 languages, in 27 programs. The address of the station is Deutsche Welle, P.O. Box 344, Cologne, Federal Republic of Germany.

WORLD RADIO CLUB

This month the B.B.C. commences its new program for the short wave listener, World Radio Club. The session replaced Short Wave Listeners' Corner, which was on the air for some years, but was cancelled last year. The new session, whose title is taken from the World Service on which it is now carried, is to be non-technical and will cover items that interest the short wave listener and radio amateur. Special reference to B.B.C. expansion plans and broadcasting techniques which the B.B.C. has adapted for their use will be featured.

Henry Hatch, of the B.B.C. Engineering Division at Bush House, London, who was a frequent contributor to the old program, has been asked to put some of his ideas into the new series. These should assist listeners to the B.B.C. to learn more about broadcasting, and also help them to improve their reception of short wave transmissions.

DX JUKE BOX

Radio Nederland's DX Juke Box program now has four contributors each month, each of whom gives DX information from his particular part of the world. The program is broadcast at 0745 GMT on Thursday on 11730, 9715 and 9525KHz, and is repeated in all English transmissions for that day. It is also carried from Bonaire. The first Thursday is Arthur Cushen's Pacific DX Report from New Zealand; on the second Thursday it is Marc Olander's Scandinavian DX report; the third Thursday is the sion for Glen Houser's North America Report, and on the fourth Thursday ten van Delft gives his Benelux D port. When a fifth Thursday occurs month, a report on the progress c European DX Council is given in th sion.

Additionally the predictions for wave reception for the month are on the first Thursday, and in each ly program listeners' letters on tec questions are answered. The program interspersed with popular music and, a sent, the lessons in the current propa course are given one week, and the lesson repeated the following week.

JAMMING INCREASES FROM EU

Earlier this year the U.S.S.R. re jamming of Radio Peking prograr Russian. These transmissions were jammed in early August, 1963, unt end of October the same year. Ir month, the Soviet Union also start jam Radio Tirana broadcasts in R and Bulgarian. The jamming of Peking transmissions was discontinued three months, but Radio Tirana is still jammed as we go to press. The U. is no longer using the traditional ty jamming. The earlier jamming periods characterised by taped callsigns in code. The new jammers do not re callsigns and the jamming noise consi extremely over-modulated distorted missions of ordinary broadcasts, repor Swiss DX Session.

LLH OSLO USES 9645KHz

A new frequency for Radio N 9645KHz with the callsign LLH, is used to serve North America 0400 GMT. In the Monday transmission E is used throughout. The station's c announcement lists 9610 and 11850K also being in the chain. On other da the week, Oslo has Norwegian in its missions, and at 0425GMT there is a minute broadcast in Spanish. The E transmission "Norway This Week" is ried on all the Sunday transmissions Oslo, with the session to New Zealan Australia taking the air 0800-0830 using 11850, 15175 and 17825KHz.

CAMBODIA USING 4935KHz

The transmissions of the Voice of bodia, in the 60-metre band, have bee served on several channels, in an a by the station to find a good clear The station is now observed on 493 with 15-minute sessions in French at and English 1245GMT, and resume normal local programs at 1300GMT stations has sessions in English 234 (Sunday 0045), 0545 and 1245GM further session 0145-0415GMT, on KHz, is a relay of the home servic further transmission is scheduled 1440GMT while news is at 0200 and GMT. Medium-wave signals from P Penh are also noted on 1425KHz wi news in English at 1245GMT. The s is notorious for not replying to list requests for verification, and is one few countries which we hear regularl have been unable to confirm.

WWV USING GMT

The National Bureau of Standards ions WWV (formerly of Washington, and now of Fort Collins, Colorado

GOOD SIGNALS FROM LATIN AMERICA

This winter season has again been noted for some excellent signals from Central and South America, both in the afternoon and late evening listening period. A survey of some of the most interesting signals, compiled from the "New Zealand DX Times" and our own observations, follows,:—

KHz	Callsign	
4925	HCRQ1	Radio Quito. Ecuador has been heard opening at 1100GMT.
4935	OAX9E	Radio Tropical, Tarapopo, Peru, opens at 1055GMT, sign on with anthem and identification announcement, also 9710 KHz.
5045	CP38	Radio Altiplano, La Paz, Bolivia, operates all night and heard 0730.
5050	YVKD	Radio Cultura, Caracas, sign on now at 1000GMT.
5060	HCRP1	Radio Catolica, Quito opens 1100GMT with prayers in Spanish.
5975	CP44	Cochabamba, Bolivia has been heard 0930-1000 after Montreal closes.
6105	HJVN	Radio Vision Medellin, Colombia heard from 1030GMT.
6120	XETS	Tapavhula, Mexico, has been heard with announcement and music after.

ıter station WWVH in Hawaii have reverted to the use of GMT for all ınnouncements. The WWV announce- recently have been in Mountain ırd Time and WWVH used Hawaiian ard Time for many years. The use of will be welcomed by listeners. The ; of both stations are well received '00, 5000, 1000 and 15000KHz. The ı has speech announcements of the in GMT each five minutes, and has ı pulses as well. Details in CW are on ionosphere conditions and recep- onditions generally. WWV signals are ; the most accurate in the world— than 1 part in 10^{10}—and can be as marker points for receiver calibra-

.C. CENTRAL AFRICAN RELAY

B.B.C. has been operating a Central n relay station at Francistown near Rhodesian border for some months. ›resent transmissions on the station, ›th medium and short-wave, are as s: 0400-0600 on 4845KHz; 0600-0830 95: 1530-2045 on 4845. The medium- relays 602 and 926KHz carry the schedule and additionally the World ɜ 0545-0600. The station carries loc- riginated programs at 0430-0445 on ays, on 602, 926 and 4845KHz.

CLANDESTINE STATIONS

long established "Radio Espana In- lencia," which has operated from years from Eastern Europe with pro- beamed at Spain, has at last been l. The station has the mailing address).B. 359 Prague, Czechoslovakia. The is on the air 0600-0630GMT on 11260, 12140KHz, and 1530-2330- on 6950, 7600, 10110KHz.

io Euzkadi, La Voz de la Resistencia (postal address P.O. Box 59, Paris rance), broadcasts in Spanish and ; daily 2030-2100. 2130-2200 and 300 on 15080, 13250KHz. The stat- nfirms reception reports by letter in ı, and identifies in Spanish, Basque ıglish.

ıew station is planned on Navassa between Haiti and Cuba. The island ıed by the United States. The trans- ; will be 50KW MW and 20KW SW, vill operate on the lines of Radio ca, with Spanish programs.

-LASHES FROM EVERYWHERE

.YSIA: Kuala Lumpur has been ob- ɜd on 5965KHz at 2255 to 0015GMT. station has commercial programs, news in English at 2330GMT. The ɔtion of Kuala Lumpur has been re- ɜd in South Africa. The station now ies with a new card showing a map of ıysia with a flag on the left hand er, and with a short history of Malay- ınd verification details on the reverse

RIA: Lagos, with the broadcasts of Voice of Nigeria, has sessions in ıch at 1300-1400, 1900-2100GMT; in sa 1400-1500; English 1500-1600, -1900 and 2100-2200; and Arabic -1700. All these transmissions are on ;, 9690, 11900KHz.

IAM NORTH: Radio Hanoi is on laily in English at 1000-1030, on 7210 KHz; 1300-1330, 1530-1600 on 1240, , 9640, 11840; and at 230-2330 on , 9840, 11840KHz.

NESIA: Djakarta, in its program ice of Indonesia," is well received on KHz with programs in English for ıin and New Zealand 1900-2000GMT. mailing address of the station is P.O. 157, Djakarta.

IANY: Radio Free Europe now broad- from Germany, and its extensive schedule gives some of the most esting reception. We have heard the KHz channel in Polish 0355-0550- T and 2110-2310GMT. They use KHz in Hungarian 0355-0530 and

STATION SCHEDULE CHANGES

RADIO PRAGUE ENGLISH SCHEDULE

Radio Prague's English language transmissions has now put into operation four frequencies in the 13 metre band, in its overseas service of English transmissions schedule, which is valid to October 22 in broadcasts from Czechosolvakia.

GMT	AREA	KHz
1200-1230	Europe	9560, 11960, 15285
1900-1930		5930. 7345.
1530-1630	Africa	6055, 11990, 15285, 17840, 21735.
1730-1830		5930, 7345, 11990, 17840, 21620.
1400-1500 (Sunday)	North America	15448, 17705, 21450.
0100-0200		7345, 11990, 15368, 17840.
0330-0430		5930, 7345, 11990, 15368.
0700 0800	N.Z., Australia	6055, 9550, 15310, 21450, 21700.

RADIO NEW ZEALAND SCHEDULE

A new schedule now in operation by Radio New Zealand, Wellington, includes the use of a new frequency 17770KHz in its Australian beam.

GMT	AREA	KHz
1700-1945	Pacific	ZL18 9520, ZL3 11780.
2000-0545		ZL21 15110.
0600-0845		ZL18 9520, ZL3 11780.
2000-2230	Australia	ZL3 11780.
2245-0545		ZL5 17770.
0900-1145		ZL18 9520, ZL3 11780.
0215-0245	Antartic (Sun. only)	ZL3 11780.
0815-0845		ZL7 6080.

During the service to Antarctic, 17770 is withdrawn 0200-0300, and 11780 at 0800-0900GMT.

The program up to 0545GMT is relayed from the NZBC Home Service, and from 0600GMT the transmisison is the special Radio New Zealand service to the Pacific and Australia.

The monthly DX Session, "Arthur Cushen's DX World" is carried on the first Wednesday at 0645 and 1030GMT on 9520, 11780, and the following Saturday at 2345GMT on 15110 and 17770KHz.

ENGLISH FROM RADIO NORWAY

Radio Norway at Oslo on Sunday each week has a 30-minute program in English called "Norway this Week," which is heard in transmissions directed to a world-wide audience. The present schedule is:

GMT	AREA	KHz
0800	Pacific, Far East, Africa.	11850, 15175, 17775, 21655*, 21730*
1200	North Europe, Pacific, Far East.	7240. 15175. 17825, 21655*, 21730*
1400	America, Indonesia, Australia.	15345, 17825, 21655*, 21730, 21670*
1600	America, Middle East, S. Africa.	15345, 17825, 21655*, 21670*, 21730
1800	America, Africa.	11850, 17825, 21655*, 21670*, 21730
2000	America and East Africa.	15345, 17825, 21730, 21655*
2200	West Europe, South America.	15345, 17825, 21730, 21655*
0000	(Monday) America.	11735, 15175, 15345, 21655*
0400	North and Central America.	9645, 11735, 11850.

Power is 120KW except when indicated with * when it is 10KW.

CHANGES FROM BERNE

The Swiss Broadcasting Corporation has altered its schedule to make each transmission of 75 minutes duration. Also, they commence 15 minutes later than formerly.

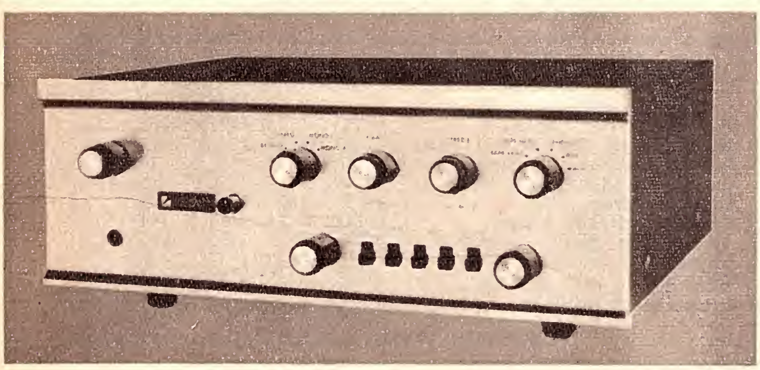
GMT	AREA	KHz
	ENGLISH	
0130-0245	North America (East)	6210, 9535, 11715
0515-0630	North America (West)	9695, 11715
0715-0830	Australia, New Zealand	9590, 11715, 17890
0915-1030	Africa	15305, 17830, 21520
1115-1230	U.K. and Ireland	9665, 11865
1315-1430	Japan, S.E. Asia	16135, 17775, 21525
1515-1630	Middle East	15305, 17830, 21540
1900-2045	U.K. and Ireland	9665, 11865
	SPANISH	
0015-0115	South America	9535, 11775, 15305, 17830
0330-0430	Central America	9535, 9695, 11715,
1400-1500	Spain	9665, 11865
2130-2230	Spain	9665, 11865
	PORTUGUESE	
1030-1100	Africa	15305, 17830, 21520
2100-2130	Portugal	9665, 11865
2315-2345	Brazil	9535, 11775, 15305, 17830
	FRENCH	
1815-1845	Africa	15160, 17845
	ARABIC	
1700-1730	North Africa	15305, 17830, 21540
1745-1815	Africa	15160, 17845

LUX SETS NEW PERFORMANCE STANDARDS

New vistas in electronics have been opened by t search division of the Lux Corporation, Japan's manufacturer of high quality amplifiers and ass equipment. Engineering and wiring are most met as detailed examination discloses. The NHK Broad Network use Lux amplifiers—and the Olympic Stad Tokyo was equipped with Lux public address s Much Lux electronic circuitry carries world wide and is exclusive to Lux amplifiers. As Australian Encel Electronics Pty. Ltd. has selected a number models; in every case the unit offers remarkable and is fully guaranteed.

THE LUX SQ-101 SOLID STATE STEREO AMPLIFIER —

This fine silicon transistor stereo amplifier is rated watts peak power output and distortion is neglig normal lounge room listening levels. Frequency re is 15-50,000 Hz. plus or minus 2 dB. Magnetic ser is 3.5 mV, tape head input 1.8 mV and additional f include unique bass and treble control circuitry per changeable crossover frequencies for both high a ranges. High cut (scratch filter), low boost (lo control), tape monitor, speaker switch, headphon and normal treble/bass controls are standard. Use 16 ohm speaker systems power output is 15 watts per channel. The audio excellence of the SQ-101 is even to the untrained ear. Earlier substantial shi sold out in a few days! ....

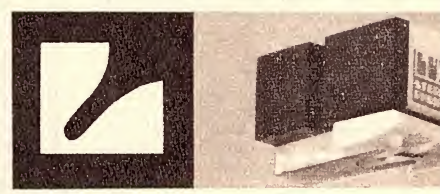


THE LUX SQ 65—30 WATTS R.M.S. PER CHANNEL

With a wide frequency response of 20-20,000 Hz. plus or minus $1\frac{1}{2}$ dB. at full output, the circuitry of the SQ 65 incorporates silicon diodes and P.P. 7868's, output being 30 watts R.M.S. in each channel. Input sensitivity is 4 mV. for magnetic p.u. Tone compensation circuits include a U.S. patented M.F.B. system and new Lux NF electronics. Substantial grain oriented output transformers of unique design are responsible for the outstanding performance of the SQ 65. Features include tape monitoring circuit, phase switch, blend control, speaker switch, headphone jack, scratch filter and rumble filter. The MFB circuitry is effective on normal speaker systems. Write for complete specifications **$199**

NEW LUX AMPLIFIER SOON TO BE RELEASED

An all new model, the SQ 1220, will soon be available. This solid state stereo unit is rated at 56 watts R.M.S. into a 16 ohm load in each channel. Production of this superlative amplifier will be restricted so enquire now! Full specifications on request. Price is expected to be very close to $300.



NEW MOVING MAGNET STEREO CARTRIDGE

The Lux T-15-M has been acclaimed as a brillia former by discriminating audio enthusiasts—fre response is conservatively quoted at 20-20,000 H stylus pressure is from 1 to $2\frac{1}{2}$ grams. Tracking a 15°, output is 5 mV. at 1 kHz. Stylus sizes availa 0.7 and 0.5 mil. conical diamonds. From a musi preciation point of view the Lux T-15-M compares ably with cartridges twice the Encel price. **$2**

LUXURIATE WITH LUX!

Encel ELECTRONICS PTY. LTD.

Head Office: 431 Bridge Rd., Richmond, Vic. Tel. 42 3762
City Branch: 18 Bourke St., Melbourne. Tel. 32 2672
Sydney Store: 257 Clarence St., Sydney. Tel. 29 4563, 29
Ground Floor, 2SM Building

Australia's Greatest Hi-Fi Centre

★ Wholesalers,
★ Trade-ins acc

)-2300GMT, while 3995KHz is used Czech 0357-0600 and 2130-2300GMT. the 13M band, Radio Free Europe scheduled on 21575 in Roumanian at -0800; 21600 in Hungarian at 0800-); 21665 in Czech at 0815-1500; 5 in Roumanian at 1500-1900; 21680 Bulgarian at 1600-1815; 21720 in h at 0800-1900; 21745KHz in Polish 810-1845GMT.

[ISLAND: The station operating from island in the Caribbean has dropped use of its short wave frequency of KHz and now uses medium wave , 1160KHz, with the power of 50KW. programs are all in Spanish from -1330 and 2200-0200GMT. The sta- has the mailing address of P.O. Box Miami, 1, Florida.

CO: Station XEO1 is reported to be d by Bob Padula of Melbourne with logan, "Radio Mil," on 6010KHz, to at 0800GMT. Other reports mention heavy sideband interference from o Havana, Cuba, using 6015KHz, h we also experience. XEFT, using KHz, and listed with 250W, has been d at 0500 at times, but also has severe band trouble. Verification from this on has been received in 14 days by a h American listener.

OCCO: This country is now verifying rts with a new folding card which the details in English, French and bic. As well, the station sends a full rage of the station's schedule on ium wave and short wave frequencies. reception at present is 1830 to 2300-T on the frequency of 11735KHz with rams beamed to Europe. The trans- er is located at Tangier and uses the er of 50W. English is heard at 2130-T on this channel.

UGAL: Lisbon is using the frequency 1660KHz, with programs from 1345 700GMT in Portuguese, beamed to Verde. Lisbon is also using 15380-, 2130-0100GMT, with Portuguese ned to Brazil, and Spanish, 0100-0145. ish to the United Kingdom is 2045- on 7130, 6025KHz, and to North rica 0200-0245 and 0345-0430 on , 6185, 6025KHz.

EN: Stockholm is now on a new dule and the changes which have notified are as follows: 0900-1030-T on 21690 (replacing 21585) to dle East: 1730-1930GMT on 15240- (17840) to Africa; 1830-1930 on 0 (11705) to Africa; 2025-2115 on 5 (11705) to North America, and -2345 on 11810 (9620) to South rica.

OCCO: Rabat has a service in Span- from 2300-2355GMT. Best reception 15390KHz. The station is also re- ed to be using 7255KHz with the program, with transmissions beam- or reception in South America.

OTES from readers should be sent ARTHUR CUSHEN, 212 Earn t, Invercargill, N.Z. All times are nwich Mean Time, add 8 hours for h, 10 hours for Sydney and 12 hours Wellington time. All frequencies in ertz (KHz) previously shown as cycles (KC).

: Damascus is using the frequency 0KHz in Arabic 1300-2300 for lis- s in North Africa when they relay Home Program. Between 1900-2300 use 15165KHz for the same program; re this time, the frequency is used its foreign language service to pe. The 15165KHz channel has been rved with English, 1600-1700 and ch, 1800-1900GMT. The service Damascus to South America has been observed on 17865KHz from -0100GMT.

IA: Station ELWA, located at Mon-, is heard in New Zealand at good at 1900GMT. The program at this is in Arabic and it continues in language to 2000GMT, when ch has been noted on the channel.

RADIO CANADA'S INTERNATIONAL SERVICE

The overseas service from Montreal, Canada includes the use of the 13 metre band for its service to Africa and Europe. The service to the South Pacific remains unchanged. The full service is:

GMT	AREA	KHz
0725-0820	Africa	9625, 5990 (B.B.C. relays 21610, 17715, 15390)
0825-0935	Aust.-New Z.	9625, 5970.
1055-1212	Europe	21460, 15365, 9625.
1215-1313	United States	15365, 11720, 9625.
1316-1342	Europe	17820, 15365, 11720.
1345-1830	Europe	21460, 17820, 15365.
1830-1958	Africa	21460, 17820, 15320.
2000-2152	Europe	21460, 17820, 15320.
2200-2250	Northern Canada	17820, 15190, 11720.
2300-0045		15190, 11945, 9625.
0100-0230	U.S.A. and S. Amer.	15190, 11720, 9625.
0230-0600	North. Canada	11720, 9625.
0600-0705	Europe	11760, 11720, 9625.

The station is also observed with English at 2200GMT, but has weakened in signal level by this time.

ITALY: Vatican Radio has altered its frequency in its service to South America, which is now beamed on 17860KHz. The station opens at 2400GMT with a program in Spanish which continues to 0020GMT. The station is well received, but suffers some sideband interference from Radio Australia on 17870KHz.

LEBANON: Beirut has moved to the 16M band for its South American service, and uses the new channel of 17760KHz. The station opens at 2300GMT with 30 minutes in Portuguese, then follows an hour in Arabic and the final 30 minutes is in Spanish to sign off at 0100GMT. Beirut has also altered its transmission in some other services to higher frequencies, for our winter reception period.

ITALY: Rome, in its service in Italian for Latin America, operates 2230 to 0100-GMT. The frequency of 17770KHz is used, and this is mixed with Radio New Zealand, as well as suffering sideband interference from Hilversum on 17775-KHz, in its Dutch service to South America.

BULGARIA: Sofia used the new 16M-band channel of 17800KHz for its service to South America. The transmission in Bulgarian is on the air 2300 to 2325GMT. This is the first time we have noted Sofia in this band. Signals are at good level, but a weaker signal on the same frequency causes some slight interference to the broadcast.

SWITZERLAND: A new 16M-channel for New Zealand reception is on the air from Berne at 0715GMT on 17890KHz. Signals are mixed with a Radio Taiwan station on the same frequency, and the Berne signals are much better on 9590 and 11775KHz. The new transmission time is also carried for reception in Europe with the program broadcast on 6165 and 9535KHz. This English transmission is not in the service to Europe on Sundays.

POLAND: Transmissions from Radio Warsaw to the British Isles are now on the following schedule: 1830-1857GMT on 9525, 7125KHz: 1930-2000 on 9525, 7285, 7125; 2030-2100 on 9675, 9540; 2130-2155 on 9525, 7125; 2230-2300 on 9540, 7285KHz.

DOMINICAN REPUBLIC: Station HIMS Radio Cristal, Apartado 1322, Santo Domingo, is operating on BC 570KHz, and also has a short-wave transmission on 5010KHz. Transmitter power is 800 watts. The station operates 1100-0500-GMT, and requests reports from overseas. Return postage is not required.

FINLAND: During the present winter period the Helsinki station's daily transmission to North America will be on 1518KHz, with English at 2300 and Finnish at 2315-1400GMT.

SWEDEN: Transmissions from Stockholm have undergone some changes. Broadcasts which have been changed are: To North America (East Coast) 0000-0230 on 11805KHz; to West Coast of North America, 0300-0430GMT on 11705KHz; to South Asia 0445-0615 on 17840KHz; to Europe 0900-1215 on 9625KHz; to Far East 1100-1215 and 1230-1330 on 15240KHz; to Australia and New Zealand, 2245-2345 on 9620KHz; to South Asia, 1400-1530 on a new frequency, 21585KHz; to Africa, 1715-1930 on 17840KHz.

BULGARIA: Radio Sofia is noted on the new channel of 11955KHz, with English transmissions to Africa, 2105-2130GMT. The same program is also carried on 11970KHz, and at 1905-1930 a transmission on 15312KHz is broadcast.

MOZAMBIQUE: The program of the Radio Club of Mozambique, Lourenco Marques, is noted on 11775KHz. The program is in English from sign on at 0330GMT. The station has opening announcements in both English and Afrikaans before programs commence at 0330-GMT.

BROADCAST BAND NEWS

PHILIPPINES: Voice of America has withdrawn its transmitter at Malolos, which has operated for many years on 920KHz with 50KW. The transmitter carried the V.O.A. programs for reception in the Philippines. The external coverage from the Philippines was handled by the transmitter on 1140KHz with the power of 1000KW broadcasting 1200-1630GMT. The other megawatt transmitter of V.O.A. in the Pacific, at Okinawa, continues to operate on 1178KHz, and is on the air 1100-1600. The V.O.A. station at Saigon on 760KHz broadcasts 1100-1630 and power is presumed to be 50KW.

THAILAND: The Australian Government through SEATO has given three transmitters to Thailand to counter Peking propaganda. The transmitters, two of 50KW and one of 10KW, are already in operation. The 50KW transmitters are at Korat, 140 miles north-east of Bangkok and Khon-Kaen, 230 miles north-east of Bangkok. The 10KW unit is at Ubol.

NEW ZEALAND: Transmission hours of several N.Z.B.C. stations have already been extended. Sign on of Hamilton 1XH is now 1700GMT on weekdays. Programs of this station are relayed by 1ZO (1420), 1ZU (1520), 1ZD (1000) and 1ZC (1350). Later this year, Taupo, 1ZA 1500KHz will join the network, which specialises in early morning music and news for farmers.

The Hawkes Bay station 2ZC, which has previously operated from studios in Napier on 1280KHz has since June also had studio facilities in Hastings and will operate from this site for half of its broadcasting time on the air. The station runs a 1800-1200GMT schedule except on Saturday, when sign on is at 1900GMT.

A.C.E. RADIO

AMPLIFICATION · COMMUNICATION · ELECTRONICS

PHONE 51-38

636 KING STREET, NEWTOWN—51-7008

136 VICTORIA ROAD, MARRICKVILLE — 51-384

K 20 CT330 · K 20 CT500

220S 4000 O.P.V.

D.C. Volts 5, 25, 125, 500, 2500. A.C. Volts 10, 50, 250, 1000. Current: 250uA, 250mA. Resistance: 0-10K, 0.1 Meg.

£3/19/6 Post 5/-

C.T.330 20K.OPV

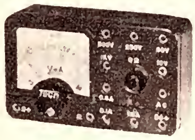
D.C. Volts 6, 6, 30, 120, 600, 1200, 3000, 6000. A.C. Volts, 6, 30, 120, 600, 1200. DC. Current, .06-6, 60, 600mA Resistance, 6K, 600K, 6meg, 60meg. D.B. minus 20 to plus 62 5 Ranges. Specially suitable for transistor use

$15.95 Post, 50c.

C.T.500 20K.OPV

D.C. Volts, 2.5, 10, 50, 250, 500, 1000, A.C. Volts, 10, 50, 250, 500, 1000, D.C. Current, .05, 5.50, 500mA. Resistance, 12K, 120K, 1.2 meg., 12 meg. D.B. minus 20 to plus 62

$13.25 Post., 50c



P.T.34 1000.OPV

D.C. Volts, 0, 10, 50, 250, 500, 1000.
A.C. Volts, 0, 10, 50, 250, 500, 1000.
M.A. 1-100-500 RESISTANCE.

$5.25 Post., 50c.

200H. 20K.OPV

D.C. Volts, 5, 25, 50 250, 500, 2500. A.C. Volts, 10, 50, 100, 500, 1000. D.C. Current, 50UA, 2.5, 250mA. Resistance, 6K, 600K. Capacitance, 2 D.B. Ranges.

$10.50 Post., 50c.

ALL PRICES NET, INC. S.-TAX.

KAMODEN HT 100B MEASUREMENT RANGES

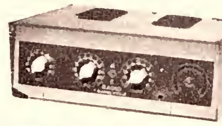
1. D.C. VOLTAGE
   Sensitivity:
   100,000 ohm/volt.
   500 mA 2.5V, 10V, 50V, 250V, 500V, 1000V.
2. A.C. VOLTAGE
   Sensitivity:
   12,500 ohm/volt.
   2.5V, 10V, 50V, 250V, 1000V.
3. VOLUME LEVELS IN DECIBELS
   20 plus or minus 62db in 5 ranges.
4. RESISTANCE

		Centre Scale
R x 1	0-20,000 ohm	160 ohm
R x 10	0-200,000 ohm	1600 ohm
R x 100	0-2 Meg. ohm	16,000 ohm
R x 1000	0-20 Meg. ohm	160,000 ohm

5. D.C. AMPERE
   10UA 250UA 2.5 mA 250 mA 10A.

$28.75
(Post $1.25)

AMPLIFIERS Public Address Range 240V-AC



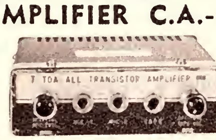
MINIATURE P.A. AMPLIFIER. 15 WATTS OUTPUT.

Multi Match Ferguson O.P. transformer Input for crystal mike and pick-up with electronic mixing, P.P. EL.84 output $39.50
30 Watt. As above, EL34 P.P. $53.50
40 Watt. As above EL34 P.P. $79.50
60 Watt. As above EL34 P.P. $98.50

LINE OR VOICE COIL TRANSFORMERS. MULLARD HI-FI RANGE.

5/10 with pre amp base and treble boost. Ultra Linear output $43.50
5/20in. As above $65.50

TRANSISTOR P.A. AMPLIFIER C.A.-512



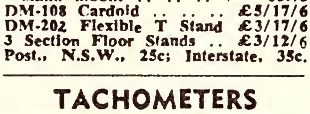
12VDC Operation.
Output 20 watts.
Current consumption at max. output 2.2 amps.
Input. High imp. mic. Also 600 ohms and tape.
Independent gain controls.
Output: Imp. 4-8-16 ohms.
Freq. Response: 200 cps—6000 cps.
Dimensions: 2in x 6¼in x 8½in.
Complete with instruction book with circuit. All plugs.

PRICE $57.50

DYNAMIC MICROPHONES

DMS-3 HI-Imp $5.50
DM-305. 600 ohms or Hi-Imp. Suitable stand mounting $9.75
DM-304 Dynamic Cardoid. 50 ohms or HI-Imp. Suitable stand mounting .. $15.75
D.M. 307 HI-Imp. £7/10/-
CM-10 Crystal HI-Imp. Suit stand mount $5.75
DM-108 Cardoid £5/17/6
DM-202 Flexible T Stand £3/17/6
3 Section Floor Stands .. £3/12/6
Post., N.S.W., 25c; Interstate, 35c.

TACHOMETERS



Mullard ACE. Scaled for 5.7 or 9K. £10/7/6—$20.75.
With Dwell Angle, £11/17/6—$23.75.
OHNAR.
240 degree, Circular Movement. Scaled 6K or 8K. £12/7/6—$24.75.
Standard Scale, 6 or 8K. £9/17/6—$19.75.
Postage: N.S.W. 5/; Interstate 7/6.

REVERBERATION UNITS

Latest design to suit organs, stereo, guitar, any hi-fi equipment.

£2/17/6 $5.75
Post. 3/6.

ELEGA REVERB. SPEAKERS

Automatic addition of reverberation to any existing amplifier. Handles 12 Watts.

£12/15/- $25.50

CO-AXIAL SPEAKERS C.S.-30. 12"

V.C. 16 ohm. Cross over 3,000 cycle. Frequency range 40 to 20,000 cycles. Rated 20 Watts.

£13/19/6 $27.95

C.S-20. 8"

V.C. 16 ohm. Cross over, 3,000 cycle. Frequency range 40 to 20,000 cycles.
Rated 8 Watts.

£7/19/6 $15.95

HORN TWEETER CT-3

2,000-20,000 Response.
20 Watts Power.
Sensitivity 110 dbw.
Weight 1¾lb.

£4/9/6 $8.95

STEREO RECORD CHANGERS

Model. 4-speed.
$21.50 £10/15/-
De Luxe Model.
Fully machined and balanced. Heavyweight turntable. Ceramic cartridge.
$27.50 £13/15/-
Post. N.S.W., $1.25; Interstate $1.75.

STEREOPHONIC HI-FI HEADPHONES

With padded earpieces.
SPECIFICATION:
Frequency Response: 25-17,000 cps
Nominal power 1 watt.
V.C. Imp. 8 ohms each channel.

$7.75 £3/17/6
Post., 50c.

TV SIGNAL-BOOSTER

240 V. operation. No change. To set. Simple connection. Extra gain on all channels.

$9.75
Post 50c.

INTER. COM. UN

2 Station Transistorised
$11.50 £5/15/
4 Station, including Mast
$20.25 £10/2/

4 CHANNEL MICROPHONE MIXER PRE AMPLIFIE

$7.75
Post., 50c.

NEW WIDE RANGE SPEAKE

15 ohm, Twin Cone.

8in .. ..
12in .. ..
5in .. ..
5in Tweeter .. ..
4in Single Tweeter .. .. ..
12in Heavy Duty 20 watt ..

NEW SPEAKER

2in, 15 ohms .. ..
2¼in, 8 ohms .. ..
2¾in, 15 ohms .. ..
3¼in, 8 ohms .. ..
3½in, 15 ohms .. ..
4in. 15 ohms .. ..
6½in, 15 ohms .. .. ..
7in x 5in, 15 ohms .. .. ..
6in, 3, 8, 15 ohms .. .. ..
8in .. ..
12in .. ..
Pus 50c post.

PANEL METER

Square. Clear Plasti

2¼in 50 UA .. ..
2⅜in 50 UA .. .. ..
2¼in V.U. Meters .. ..
3⅜in 1mA .. ..
2¼in 500V A.C. .. .. ..
2¼in 500V D.C. .. .. ..
3⅜in 500V A.C. .. .. ..
3⅜ 500V D.C. .. .. ..
Post N.S.W. 25c. Interstate

NEW RECORDIN TAPE

	£
3in Mylar LP 300ft ..	
5in Mylar LP 900ft ..	1
5in Mylar DP 1200ft ..	1
5¾in Mylar LP 12000ft ..	1
5¾in Mylar DP 1800ft ..	1
7in P.V.C. 1200ft	1
7in Mylar LP 1800	1
7in Mylar DP 2400ft	2
10½in Mylar LP 3600ft ..	3

Post 26 per spool.

PLAYMASTER 4 STEREO AMPLIFIE

Push-Pull. 8 Watt per Ch Bass and Treble boost and
Wired and Tested.

£38/10/- $77.0

ELECTRIC GUITA

Pickup Units .. ..
Accordion Pickup Units ..
Harmonica Pickup Units ..
Post., N.S.W. 40c; Interstate,

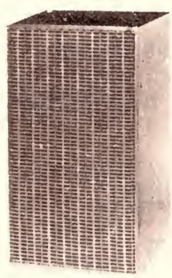
BATTERY CHARGER

240 Volt A.C. Operation
3 Rate 6V, 12V TRICKLE CHARGE

:kle Charge Position suits all Batteries. 2V to 12V at rate of 200 to 500 M.A.

STANDARD		DE LUXE	
·. 6V, 12V, TRC ..	$11.50	3 amp.	$16.75
·. 6V, 12V, TRC ..	$12.25	4 amp.	$19.75
·. 6V, 12V, TRC ..	$15.25	6 amp.	$21.75
· 6V, 12V	$15.95	10 amp.	$27.75
N.S.W. 75c. Inters ate $1.25.		Rail or Air Freight on.	

MULLARD MAGNAVOX



3OOKSHELF ENCLOSURE
Maple, Teak or Walnut
Complete $26.00
PER BOOKSHELF $40.50
:t: N.S.W. 50c, Intersta.e $1.00.

PLAYMASTER BOOKSHELF UNITS

5in	8in	12in
$29.50	$33.50	$36.50

GUITAR AMPLIFIERS

t, Two Channel, with Twin Speaker .. $53.55 £26/15/
t, 4 Inputs, Bass and Treble 2 Twin Speakers .. $63.00 £31/10/
t, Four-Channel, Bass and Boost. Two one Speakers $76.25 £38/2/6

35 WATT

nel, Bass and Treble Boost. ı Cone
rs $109.05 £54/10/6
with foot control and 2 pre-trols for frequency and in- $10.50 (£5/5/) extra on models.

4 plus 14 WATT

Reverberation. May be used Watt or as 14 Watt plus 14 Reverb. Two 9 x 6 Woofer rs. Two 9 x 6 Twin-Cone rs. 4 Channels. Bass and Boost. Foot Vibrato control d.

163.50 £81/15/-

BASS OR BASS GUITAR
0 WATT AMPLIFIER
t Channels. Bass and Treble Two 12in Radial Beam rs. Perfect reproduction on les.

145.75 £72/17/6

PIGGY BACK
JITAR AMPLIFIER

tt $79.75
tt $99.75
tt $119.75
ts. Bass and Treble Boost.) if required, $10.50 extra.

LAYMASTER 116
GUITAR AMPLIFIER
:t $79.95
and tested $91.95

REVERBERATION-PRE-AMPLIFIER

2-Channel input. Fully transistorised. A.C. Powered.
Plugs into and matches any Guitar, Organ or P.A. Amplifier.

£29/17/6 $59.75

TAPE ECHO UNIT

Suits any Guitar amp. without any alteration.
JUST PLUG IN.

$139.50

PLAYMASTER 106 AND 107

Feb. and March Elect. Aust.

106
WIRED AND TESTED. **$88.75**

107
WIRED AND TESTED **$79.00**

V.T.V.M. MODEL TE-40 MILLIVOLTER

Spec. AC.V. Imv.—300 Vrms. 10 ranges. Accuracy 5 cps—1.2 mc, plus-minus 2dB. 10 cps-1 mc. plus-minus 1dB. 20 cps-250 KC.. plus-minus 0.2dB.
dB. Scale: 40-30-20-10.0. 10.20, 30.40, 50 dBm. 240 V.A.C.

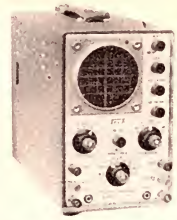
$47.50.

MODEL TE-65 V.T.V.M.

DC.V 0-1.5-5-15-50-150-500-1500 V. Rms. AC.V. 0-1.5-5-15-50-150-500-1500 V Rms. 0-1.4-4-14-40-140-400-1400-4000 V. P.P.
Resistance RX10.100, .1K. .10K, .100K. .1M. .10M. Decibel—10db, minus-plus 65dB.
240 V.A.C.

$42.50

TEST EQUIPMENT

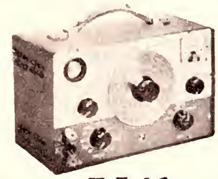


WIDE BAND OSCILLOSCOPE

5 Meg. Bandwidth. Push-pull vertical and horizontal Amplifiers. 8 position, high sensitivity vertical Amplifier, Frequency Compensated on all positions. Calibrated .02 to 600 volt. Hard-time base, 20 cycles to 75K. Latest American R.C.A. circuitry. Complete with probe.

3-inch $99.75; 5-inch $111.50

T.O.2 TV portable service unit 2" oscilloscope $59 50.
C.R.O. DOUBLE BEAM SWITCHING UNITS
$39.75



T.E.46 RESISTANCE-CAPACITANCE

Bridge and Analyser.
Capacity 20 pfd to 2,000 mfd. Resistance 2 ohm to 200 megs. Also tests power, factor, leakage, impedance, transformer ratio, insulation resistance to 200 megs. at 600V.

Indications by eye and meter.

$47.75

LEADER SWEEP & MARKER GENERATOR SMG 532

TV and F.M. 2 to 270 Megs. 5.5 Meg. Crystal for TV sound. Sweep width to 12 Megs. Model 531.

$170.00

Post., N.S.W. $1.50; Interstate, $2.50

SIGNAL GENERATOR

Deluxe Model TE 20D.

Freq. range 120 KC—500 Mcs. 7 Bands. Accuracy 2 per cent. Output 8V. Provision for Xtal. Suitable for self calibration. Marker generator. Printed circuit. 240 V.A.C.

$27.50

Post., N.S.W. $75c; Interstate $1.25.

T.C. 2

VALVE TESTER

Tests all valves, diodes, rectifiers, checking filaments, shorts. Merit on direct reading. Good-bad meter. Complete with tube chart.

$26.75

Post, N.S.W. 25c; Interstate $1.25.

T.E. 50.—99—5011
Checks, Nu Vistas. Compactrons, etc.

$34.25

G.D.O. UNITS

Leader. 810. 6-Band. 2 Meg to 260 Meg Nuvistorised, 240 V.A.C. Operation. Modulated. Calibration. Accuracy 2 per cent.

$41.50

T.E. 18 Lafayette. 8 Bands. 360 K.C. to 260 Megs. 240 V.A.C. operation

$39.50

Post, N.S.W., 50c; Interstate, 75c.
T.E. 15 Transistorised. 7 Band, 360 Kc to 270 Megs.

$34.75

AUDIO GENERATOR

DeLuxe Model TE—22D.

Freq. range. Sine 20 cps—200 KC. SQ. 20 cps—25KC. Output voltage. Sine 7V. SQ. TV P-P. Output impedance 1000 ohms. Acc. 5 per cent. Distortion less than 2 per cent. 4-range attenuation.
1/1, 1/10, 1/100, 1/1K. Printed circuit.
240 V.A.C.

$41.50

Post. N.S.W $1.00; Interstate $1.50

PLAYMASTER 115

The new solid state Stereo-Amplifier. April Issue.

Wired and Tested	$104.00
Kit Set	$90.00
Pre-amp to suit magnetic cartridge	$12.00

ANSWERS TO CORRESPONDENTS

ıen writing to us:—

- *Please give you name and full postal address including the State.*
- *Write the above information clearly or, for preference, print it in block letters. Your co-operation will facilitate delivery of replies by mail, where such are called for.*

O RECEIVER: Would it be possible to develop a receiver to cover the S band used by spacecraft in the project? There are hundreds, per- ɔusands, interested in tracking satel- l space probes using these frequen- 2100 to 2300MHz. **(P.G., Brisbane,**

modestly observe, this is a pretty er, but we wonder whether you ıst how tall it is. It is a very different ion from the "Fremodynes" and onverters, to say nothing of the problems involved. Right at the , the chances of us doing much : are slight.

HURTS! Leaders in intelligent in the U.S. have announced quite ıat they have no intention of chang- Hertz from cps. I have been as- with the game for a long time and y present interests are restricted to nd SSB I also have an interest g people. The change to Hertz is of a rebellion by the so-called in- ls who have done damage to the art, etc. Mini skirts, junk art, the wn in moral values are all part of **)., Leederville, Tas.).**

:atements like those ought to qualify e kind of a prize. We would have the technical men behind the U.S. Bureau of Standards, behind highly journals and learned societies and electronically involved corporations nably intelligent people. Nor can uite as intimate a connection as you Hertz and loose morals. Presumably must really have started way back her' men's names began to be allo- electrical quantities. You're allowed ike the term and to avoid its use; e to it might conceivably reverse g to its adoption — but we cer- on't go along with your line of g.

IG 78RPM RECORDS: What potentiometer is used in the "Basic mplifier" for tone and volume con- it all right to play mono discs stereo pickup? By the way, any ıterested in playing 78 rpm records ɔbtain the book "Mullard Circuits ıdio Amplifiers." **(P. C., Taral-)**

ou for the suggestion about the .C. The potentiometers used for ınd tone controls in amplifiers are ogarithmic. However, for a project 3asic" type, any available pot could at least for the tone conrol without letriment to the performance. The ıf playing mono records with stereo was discussed in "Know Your ıone, Part 6" in our January. 1967, this article explains at some length, lts depend on the type of stylus , in general, there is no objection actice.

IMPEDANCE, etc. What is meant rce follower having a gain of 0.9? ave trouble in understanding impe- atching and think that these would le subjects for the "Answer Man."

I enjoy reading the magazine and am fascinated to see how it has changed. Twenty years ago it was written in a more personal, light-hearted way, although "Let's Buy An Argument" for August 1961 rates as just about the funniest article ever presented in The journal. **(F.A., Caulfield, Vic).**

Thanks for your kind comments, F.A., we certainly appreciate readers letting us know how they feel about the magazine. Quite deliberately, we have had to modify our "Let's have fun-hobby" approach, but electronics has come of age since the early days of "Radio and Hobbies." We must be somewhat more professional in our approach, to keep in line with the tone of the industry. Yes, we will certainly pass your questions to the "Answer Man," as these are problems common to many.

HEATER VOLTAGE: The heater voltage from a particular power transformer in my possession measures 7.8 volts with a load current of 0.3 amp. and the valves in the small set which it supplies have been lasting only a few months. I understand that heater voltage should be within about 10 per cent of the rated value. By the way, the cost of electronic components, with tax, is far too high. **(G. D. Glenroy, Vic.)**

It is possible that the transformer you have is a faulty one but, before criticising the manufacturer too roundly, it may be wise to consider certain relevant points. Firstly, is the heater winding, and the whole transformer for that matter, being used at somewhere near its rated load? If it is very lightly loaded, the voltage will be higher than at its proper rated current. Again, it may be necessary to consider the normal mains voltage in your area and note whether you are using the appropriate primary tapping. And what of your multimeter? It could easily be several per cent out, especially on the low AC volts range. In short, are the figures quoted to be accepted as proof of the manufacturer's negligence or are they the result of a number of small inaccuracies adding up to present an alarming result? In car radio service, valves may be called upon to operate intermittently at up to 7.5 volts or 15 volts respectively for 6 and 12-volt systems but the valves fortunately seem to cope reasonably well with the situation. Your figure of 7.8 volts is higher than this again but, even so, the rate at which you are going through valves seems rather startling. The fact that a couple of these were of indeterminate age and origin might suggest possible failure for other reasons. However, we could not support the idea of running valves unnecessarily at such a high heater voltage and if, in fact, you can verify your figures, it would seem desirable either to take the matter up with the manufacturers or to insert a series resistor in the heater circuit. Yes, the cost of components is high and nobody is more concerned about this than we are. Unfortunately, there is no easy answer to this. If the Government has to extract a certain amount of revenue to carry on, and the work force as a whole is determined to maintain a certain standard of living, the tax and labour content of components is inevitably going to be substantial. The situation is not peculiar to Australia, though it is aggravated by our relatively limited market potential.

DEAD LETTERS: A letter addressed to **Mr Trimarchi Francesco,** Hendon, S.A.— the only address given — has been returned by the postal authorities marked "not known." Will the writer please supply a more detailed address so that his letter and issue may be delivered. We are holding a letter from **Mr S. Gilchrist,** who gives his address as 68 Eldorado Street, T. Hill. Since we can find no reference to such a post-office in any Australian State we suggest Mr Gilchrist write again giving a more complete address.

"ELECTRONICS Australia" Information Service

As a service to readers "ELECTRONICS Australia" is able to offer: (1) Photographs, dye-line prints and other filed material to do with constructional projects and (2) A strictly limited degree of personalised assistance by mail or by reply through the columns of the magazine. Details are set out below:

REPRINTS: For a 20c fee, we will supply circuit data, as available from our files. The amount of data available varies but in no case does it include material additional to that already published in the magazine. For complicated projects involving material extracted from more than one issue, an extra fee may be requested. As a rule, requests for circuit data will be answered more speedily if the circuits are positively identified and the request is not complicated by questions requiring the attention of technical personnel. Where articles are not on file, we can usually provide a photostat copy at 20c PER PAGE.

PHOTOGRAPHS, DYE-LINE PRINTS: Original photographs are available for most of our projects, from 50c plus 8c postage for a 6in x 8in glossy print. In addition, chassis dye-line prints are available for most projects for 50c each; these show dimensions and the positions of holes and cut-outs for metal-working but give no details of wiring.

BACK NUMBERS: A fairly good selection is available. On issues up to 6 months old there is a surcharge of 5c. On issue from seven to 12 months old the surcharge is 10c. Over 12 months, it is 20c. Package and postage is 10c extra.

REPLIES BY POST: This provision is made primarily to assist readers in matters relating directly to articles and projects published in "ELECTRONICS Australia" within the last twelve months. Note, however, that we cannot provide lengthy answers, undertake special research or modifications to basic designs. A 20c query fee must be enclosed with letters to which a postal reply is required; the inclusion of an extra fee does not entitle correspondents to special consideration.

OTHER QUERIES: Technical queries which fall outside the scope of "Replies by Post" may be submitted without fee and may be answered through the columns of the magazine at the discretion of the Editor. Technical queries will not be answered by telephone.

COMMERCIAL EQUIPMENT: "ELECTRONICS Australia" does not maintain a directory of commercial equipment, or circuit files of commercial or ex-disposals receivers, amplifiers, etc. We are therefore not in a position to comment on proposed adaptation of such equipment, or on its general design. Prices, specifications or other assistance must be sought from the appropriate advertiser or agent.

REMITTANCES: These must be in a form negotiable in Australia. Where the charge may be in doubt, an open cheque, endorsed with a limitation, is recommended.

ADDRESS: All requests for data and information, as set out above, should be directed to The Assistant Editor, "ELECTRONICS Australia," Box 2728 G.P.O., Sydney, New South Wales. Other correspondence should be directed to The Editor.

SOUND PROJECTORS
Cinevox Prefect 16mm in good working order. 240v operated, complete with speaker and amplifier.
£57-10-0 $115.00

CIRCULAR SLIDE RULE
3¼in diameter. Will do the same work as the conventional slide rule. Instruction book included.
12/6 $1.25 each
Post 10 cents

REFLECTOR GUNSIGHT
Contains these lenses:
1 Lens 1in Focus, 1½in diam.
1 Lens 1 11/16in Focus, 1¼in diameter.
1 Air-spaced Lens, 1¼in diam.
1 Filter Lens, 1 Graticule, 1 Lampholder.
18/6 $1.85
Post: N.S.W., 30c; Interstate, 40c.

P.M.G. TYPE TELEPHONES
Standard desk type with magneto calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line.
£11-10-0 $23.00
(2 TELEPHONE SETS)
30c cartage to rail. Freight payable at nearest attended railway station.

AERIAL CAMERAS
F.24 Mark IV 2.9 Lens, stops 11, 8. 5.6, 4, 2.9.
With 3in x 8in F1 Dallmeyer Lenses complete with wooden case.
£19-10-0 $39.00
50c Cartage to Rail. Freight payable at nearest attended railway station.

SHIPS' CLOCKS
(No bell). Smith's 8-day, fully jewelled. Original cost $120. Special 7in brass $25. 10½in Seth Thomas splash-proofed bakelite
£15 $30
Post N.S.W., 70c; Interstate, 95c.

MINIATURE ELECTRIC MOTORS
1½ to 3 volts DC, ideal for model boats, cars, planes, etc. Strong torque. Only
39 cents each
(Post 7c)

TELEPHONE WIRE
21 gauge copper, plastic covered. Ideal telephone or bell wire. 1,320ft coil of twin (equal ½ mile). $7.00 per coil.
Post, N.S.W. 70c; Interstate $1.20.

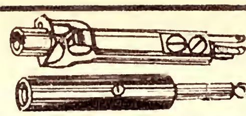
3000 TYPE RELAYS
P.M.G. 200 Ohm — 1,500 Ohm Coils, $1.25 each.

AWA OSCILLOSCOPE
Calibrated with delay time base. 5in, 240 vac., perfect.
£97-10-0 $195.00

AMPLIFIER
Subminiature 4-Transistor, Audio Push-Pull.
£3-10-0 $7.00 Post 50c

GOOSE NECK LAMP
NEW. IDEAL FOR DESK or WORK BENCH. Adjustable shade, strong metal lacquered base and frame. Height 18in. Complete with lead.
12/6 $1.25
Post and packing. $1.00.

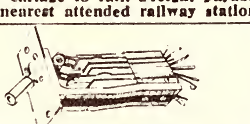
HAND BEARING COMPASS
Brand new in wooden carrying case, complete with batteries.
£17/10/- $35.00
Post, N.S.W. 70c; Interstate, 95c.



P.M.G. Phone Jack and plugs, 25c each, 45c the pair.
Post 7c.

NIFE CELLS
1.2 Volt fully charged, 4in x 3in x 1in 4 AH.
10/- $1.00 each
Post, N.S.W., 25c; Interstate, 35c.
1.2 volts 15 AH, 8in x 4in x 2in, $2.95.
2.4 volt 10 AH, 6in x 2½in x 2in. $2.50.
Post, N.S.W., 30c; Interstate, 40c.

PERSPEX
Slightly domed shape, 16in x 12in, $1.55. 2ft 6in x 18in tapering to 6in, $1.75. 2ft 6in x 2ft, $2.45. Domed approximately 3ft 6in x 2ft, $5.50.
50c cartage to rail. Freight payable at nearest attended railway station.

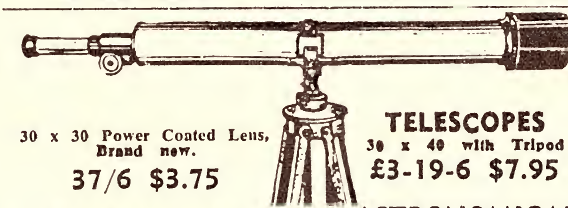


P.M.G. TYPE KEY SWITCHES. 45c each. Post, 15c.

VALVES
BRAND NEW
IN CARTONS.
Special discount for quantity

807	$1.75	6AG5	50c
6SN7GT	95c	12AU7	$1.00
89	$1.00	X61M	$2.20
12SA7	$1.25	CV850	$1.50
6H6	45c	1H6G	30c
41	$1.25	832	$5.00
5U4G	95c	6F13	75c
77	$1.00	6AK5	$1.50
VR150-30	$1.00	6X4	$1.00
5CP1	$3.95	6F8	75c
EF50	35c	6N7	$1.00
6U7	75c	12SK7	80c
V1103	$1.00	VR1120	80c
VH120	75c	VR118	75c
1L4	$1.00	VR65	25c
5Y3	$1.50	VT4C	75c
6C4	80c	AU5	$1.00
CV2184	$2.25	80	$1.25
2 x 2	75c	6AK5W	$1.50

PLEASE ADD POSTAGE ON ALL ARTICLES.



30 x 30 Power Coated Lens, Brand new.
37/6 $3.75

60 magnification with a 60mm coated objective lens. With Tripod.
£11-10 $23.00

As illustrated.
Postage, 95c; Interstate $1.20.

TELESCOPES
30 x 40 with Tripod
£3-19-6 $7.95

ASTRONOMICAL TELESCOPES
3¼" Reflector. 126 Magnification complete with 4X Finder and Equatorial Mount.
£29-10-0 $59.00
Post N.S.W. 70c, Interstate $1.20

HIGH STABILITY RESISTORS
I.R.C. brand new ½w., 1w, 2w, tolerances between 1 and not exceeding 5% including 100, 360, 560, 750, 15K, 22K, 27K, 100K, 180K, 220K, 560K, 820K, ohms. Usual price 40c each, 50 assorted different values for only
37/6 $3.75
Post 15 cents

GENUINE VARIACS
0-115 V.A.C. 18 Amps, $29 each, or couple 2 together for 240 V.A.C.
The two for $45

Genuine American Zenith Variacs
0-115 V.A.C. 7.5 Amps, $19.50 each or couple two together for 240 V.A.C.
The two for $36.
50c cartage to rail. Freight payable at nearest attended railway station.

522 TRANSCEIVERS
100 to 150 m/cs.
£17-10-0 $35.00

KLYSTRON MIXER/DUPLEX units, 9375 megs, complete with crystals, $13, £6/10/- each. Post. N.S.W., 45c; Interstate, 50c.

FRACTIONAL 240V AC MOTOR
1/25 h.p., new, with coupled 2-speed gearbox. 1425 and 300 r.p.m. Ideal for rumbler, etc.
£10-0-0 $20.00
Post N.S.W., 70c; Interstate, 95c.

SWITCH BOARD FRAMES
Steel ex-P.M.G. Height 45in x 27in x 34in will make ideal test bench. £5 — $10.
Freight payable at nearest attended railway station.

C.M.A. CABLE
240 volt 3/.036 black, new and perfect. 100 yds. rolls, $3.00. 6 or more.
£1-5-0 $2.50
30c cartage to rail. Freight payable at nearest attended railway station.

MICROMETERS
Brand new Goodell-Pratt, 0 to 1in, $7.50; Slocombe, 1in-2in, $7.85; Starrett 1in-2in, $9.85.
Post, 32c.
CHOKES, 7.5H, 60mA 95c
VIBRATORS, 6 volts, 7-pin, 75c each.
UNISELECTORS, 4 BANK, $4.00
INVERTERS, 26v-115v 2Kw 400 cycle $9.50
HAND MICROPHONES, with Press-to-Talk Switch .. 95c ea.
Post, N.S.W., 25c; Interstate, 30c.
INSTRUMENT TRIPODS, sturdy wooden frame. Telescopic Extend to 4ft 6in $13.00
SELSYN MOTORS MAGSLIP Mk. II .. .. $5.25 ea.
No. 19 2-way radios, with hand set, power supply, leads. $35.00
Meggers, bridge type, complete and tested $75.00
EVERSHED and VIGNOLES, 500 volts.

BINOCULARS
PRISMATIC. Coated Lenses.
Brand new. Complete with case.

8 x 30	$18.75
7 x 50	$22.15
10 x 50	$23.07
12 x 50	$23.95
20 x 50	$24.75

Post, N.S.W. 70c; Interstate, $1.20

ELECTRONIC K
With solar cell can exp with 20 different circuits, in wireless, microphone, morse transistor radio, audio fre amplifier, telegraph, tran intercom., signal tracer, etc tools, no soldering. Ea assemble. Assembly manu cluded.
$19.95
Post N.S.W. 45c, interstat

MINE DETECTOR
Ex A.M.F. No. 2 Mk. Instruction Book. Comp wooden case, $39.00. Freig able at nearest attended station.

4 DIGIT RELAY COUN
50-volt D.C., suit slot ca counters, etc.
$1.25. 12/6 each.
Post 13c.

RECORDING TAPI
SCOTCH BRAND.
EX-WOOMERA.
SLIGHTLY USED.
PERFECT ORDER
Ideal for professional q audio recording.
1200ft 7in reel ¼in $2.75. P
600ft 5in reel ¼in $1.68. P
200ft 3in reel ¼in 65c. P

CRYSTAL CALIBRA
With 500kc crystal up to 3 used, good condition. (\$9.75).

ALTEC STUDIO MICROPHONES
639B Western Electric, top original cost $250, ideal cast Studio, music re Church and play recordin £45, $90.

SCOOP PURCHAS
Gramo. Motors, New. U.S.A. 4-speed. 240 vol 50 cyc. Only $2.75 each. Post, N.S.W., 30c; Intersta

240-110 VOLT 6K TRANSFORMER
Encased, including switch new, $50. £25.

SPECIAL lucky dip valve 15 new valves in carto only $2.00. We haven't to sort them, so you r benefit. Post, 30c.

SOLENOIDS
Plunger Type 12V 300M. electric camera control, m trains, radio, etc.
$1.25. Post 10c.
200 Mill. amp., 24 volt, push movement.
$1.25. Post, 10c.

BATTERY CHARG
6 or 12-volt, 2½ amp, w meter, $10.50, £5/5
2½ amp with meter, $12.60, £6/6/-
Post. N.S.W., 70c; Intersta

TELEPHONES
Sound Powered. Can be Microphone and Receiver With 50ft cable.
$3.85 pair.
Post, 25c; Interstate, 4

CARPHONES
A.W.A. or S.T.C.
Two-way radio. 75-80 megs, 12-volt operated. £22/10 each.

EX ARMY TELESC
4 x 40 Handley, $6.50.
7 x 40 Otway angle te $9.85. Freight payable at attended railway station.

Deitch Bros
70 OXFORD STREET, SYDNE
SORRY, NO C.O.D.

TRIC GUITAR AMPLIFIERS: Do e available circuit data, etc., for a "solid state" guitar amplifier with tional facility of a dynamic microput? **(J. McQ., Cringila, N.S.W.).**

have not described such an amplifier yet, although we certainly intend a look at the proposition as soon re clear of the valve type circuits. , we would be very surprised if the r designs did not turn out to be a il more expensive.

AN CONSTRUCTOR. I have been radio construction since 1912, and n the Signals in the first War. I ilt many receivers since. I have New Zealand since retiring 15 years d have every type of test equip- my workshop. I have had a lot of with VHF receivers and would like ct R.B. of Auckland, who wrote in ch issue of his experiences with re- and anyone else with similar in- **E. M. Carpenter, 27 Towai Street, iers, Auckland 5, New Zealand. uckland 587284).**

always glad to hear from such sts and leave it to R.B. and others the necessary contact.

ATION SUGGESTIONS. Would it ole to print the common wire gauges ir dimensions in inches and centi- Also, will you publish a two-tran- e recorder to record tapes at school -back at home later? I am also d in the history of radio, etc., and if you could publish a general n this. **(A.Y., Sunshine, Melbourne,**

are interesting suggestions, A.Y., e will consider. The wire data can d in many reference works, but publish tables at some future date. istory can also be read in ooks, but it could take too much d occupy too much space to be ed at present. The portable tape re- ounds fine, but it would be difficult mpossible to obtain the mechanical n any case, it is possible to buy ecorders which would probably be ough for the purpose you have in

R AMPLIFIER. Would it be to publish a guitar amplifier of .0 to 25 watts with a vibrato or using low cost parts for the younger **(P.G., Kogarah, N.S.W.).**

lished a guitar amplifier in October, er, and December, 1962, and in , 1963, which meets your perform- ecifications, P.G., but it may be nore costly than you are hoping for. possible to get something for noth- ., and if you want a good output tras, you must be prepared to pay

PROBLEM: I would like to suggest er problem which could be solved e recently-described Digital Demon- — the old teaser about the farmer goose, a fox and a bag of corn, who oss a river in a boat capable of only himself and one of these with- ving alone either the fox and the or the goose and the corn. Using symbols and a Karnaugh map one l a minimal expression of the "dis- ' combinations of the "variables," one can set up the NOR gates of nonstrator to detect these as repre- by the four flip-flops (one flip-flop iting each variable as "this side" or ide"). Push buttons can then be find a sequence of operations which ake the flip-flop from "All this side" that side" without passing through the "disastrous" combinations. There obably many puzzles like this one could be solved quite dramatically using the demonstrator in a similar fashion. **(P.G., Bondi Junction, N.S.W.)**

Many thanks for the letter, P.G., and we agree that one can certainly use the demonstrator in this fashion. However we imagine that in most cases one would really need somewhat more hardware than is provided by the basic demonstrator; even in the problem which you mention. this would be true if the demonstrator were to be used to actually **find** the answer rather than simply provide a convenient means of checking a sequence already worked out on paper. Unless the additional hardware were added. the Karnaugh map alone would probably be of almost as much value as the demonstrator. Still, we're happy the unit is providing food for thought!

METRONOME . . . PLUS! I have been a keen reader of your magazine since 1947, have built many projects and enjoyed the many theoretical articles. It has been pleasing to watch the magazine grow in size and sophistication, keeping up with changes in the industry. Referring in particular to electronic metronomes and the one with accented beat, would you consider the idea of (1) a metronome feeding a pulse of light to all music stands in a band, the tempo being under control of the conductor and (2) developing from the metronome an electronic percussion generator, such as is used sometimes with electronic organs? **(M.W., Blackburn, Vic.).**

Thank you for your very kind and encouraging remarks. We would have serious doubts about the idea of an electronic metronome to control a complete group. Electrically it should not present any insuperable problems but musically it might. If heeded, it would probably result in an unduly "mechanical" beat: if not heeded, it would lead to chaos. We've already had a look at the second idea, with a tentative hook-up between the accented metronome and our earlier white noise generator. Our impression was that an elementary hook-up was not worthwhile and that a lot of extra circuitry would have to be added to control envelope shape and frequency content. In short, it looked like involving a major effort, not just something that could be strung together from a few bits. We are still very interested in the whole idea, however.

RADIO CONTROL: What is the size of the printed wiring board for the "radio control" transmitter featured in the December, 1965 issue of the magazine? **(J.H., Daylesford, Vic.)**

The size of the board was 2-1/8 x 5-1/8 inches. It was available at the time from Silvertone Electronics of 727 Prince's Highway, Tempe, N.S.W.

CAR RADIO: I have a car radio which is unsuitable for my car because of the wrong polarity. Heaters and plates run directly from the car battery. Do you have a power supply design which could run this set from the power mains? **(K.C., New Lambton Heights, N.S.W.).**

Most car radios have provision for changing polarity to suit the car and, before you write this one off on this account, seek the advice of someone in your area who specialises in this type of receiver. On the other hand, it may be that the set is one of the very limited breed in which the plate circuits operated at 12 volts and that the polarity is not easy to change on this account. Still ask, however! No, we don't have any power supplies designed to operate car radios from the mains. We couldn't undertake to work one out especially for you. Whatever the type of receiver, the best way to tackle such a proposition is to separate out the heater and high tension circuits, with a view to operating the heaters from an AC heater winding of suitable voltage on a power transformer. This greatly simplifies the problem of providing filtered DC for the plates and screens, whether this needs to be a modest 12 volts or the more usual 200 odd volts. In thinking of measures along these lines you had best be sure that the whole effort will be worthwhile. Spend too much and you will find yourself wishing that you had put the money towards a new or second-hand set of more suitable design.

TRAIN CONTROL-PLUS! Why not produce an article combining the ideas used in the model train controllers of April 1960 (which permitted individual control of several trains on the one track) and of March, 1967 (which included simulated inertia)? This would just about make the model train enthusiast's dreams come true and would nicely round out the series of articles on controllers. **(K. L., Rosanna, Vic.)**

It may be possible to combine these two projects in the manner you suggest K.L., but our impression is that it would result in a very complex set-up and one which would require a lot of equipment to be packed into the rolling stock. There is also the problem that the April 1960 design does not lend itself to simple reverse facilities, a limitation which is unacceptable to many enthusiasts and which is quite difficult to overcome. Nevertheless, we will keep the idea in mind in the hope that we may find a solution to these problems.

ANSWERS TO CORRESPONDENTS—Co

SPECIAL DESIGN. I am very plea the results which I have obtained single transistor reflex receiver pub June, 1963. Would you design a amplifier for me using two tran which I have on hand. I would pleased to pay for this service. **(J Dalyston, Vic.)**

We are pleased that you have been cessful with the simple receiver, but not help you with your design since our staff is fully occupied in of producing the magazine and cop the relevant services which are offered. To set up a section to cc the "special" problems of individual would be an involved and costly o even assuming that it was practic the present shortage of technical p having the necessarily wide bac The charges would probably have quite steep to make such a servic even.

2-WAY RADIO. With reference t Tyrer's article on the new 30KHz se for VHF mobile stations (June 1 would say "Amen"—particularly paragraphs concerning loss of s noise ratio in FM equipment. **(S. I land, N.S.W.)**

There have been a lot of argumen this subject but there seems little do narrowing the bandwidth is making harder to justify claims for superio mance from FM. In fact, it is no question of narrowing the gap them. The advantage is likely to degree or disappear altogether, de on the kind of noise involved and th strength in the relevant receiving are

DISCARDED PARTS. Could you some addresses of people who m surplus radio parts in their junk bo they would be willing to give away. like to take up the hobby of buildin but I feel that it would be too exper me if I have to buy all new parts arrange to pick up any parts t offered. **(J. W. B., Liverpool, N.S.W.)**

Unfortunately, we cannot allow the to develop into a free exchange n readers, much as we sympathise wi needs and problems. For one th simply cannot afford the space for service, since it would be a case of —all in!" For another, there is a v risk that such a service could be seiz as a form of free advertising—offerin thing free as a means of establishir mercial contacts with readers.

FREMODYNE FOUR: I would enlarged circuit diagram of the Fre Four, instructions, price of a where to buy it. **(G. L., Brisbane,**

A copy of the complete article is a for 20c, but we cannot supply a larged" circuit. For details of kits etc. you will have to consult our isers.

READER BUILT IT

(Continued from page 89)

Editorial note: If a speaker of impedance than 150 ohms is use transformer matching, it would b desirable to fit an emitter resis TR4 to prevent thermal runaway would be even more desirable w than with 6V operation. A resis 47 ohms should be satisfactory, by with a high value, low voltage lytic capacitor. The bias resisto need to be altered in value to the operating current, but this necessary in any case, if trans coupling is used in place of a impedance speaker.

CLASSIFIED ADVERTISING

Advertisements in these columns cost $0.60 per line. Each line contains the equivalent of five words each of nine letters. Minimum size of advertisements is two lines. Please note PAYMENT MUST ACCOMPANY ALL ADVERTISEMENTS EXCEPT THOSE PLACED BY ACCREDITED AGENCIES. Your advertisement for the August issue must reach our office before July 5th. Address your advertisements to the Advertising Manager, ELECTRONICS Australia, Box 2728, G.P.O., Sydney.

FOR SALE

IED Walnut Mini-speaker cabinets of Mullard design avail. $16.75 ready for ion of your own speakers (Magnavox and 3 TC's can be reasonably purchased dealer). Complete unit also avail. $27.25. tor, R. R. Wheeler, 8-10 Frederick Street, N.S.W. Freight 75c.

BUILT TRANSFORMERS. Power, Audio, ngle or quantity production. Amplifiers. stems, battery chargers. Rectfiers, electric transistor radios, general engineering, fit- turning, sheet metal work, etc. Parkin- nsformers, P.O. Box 523, South Brisbane. Beenleigh 33.

ONE 84C communications receiver 0V AC/DC. Range 30MC-480KC. Out- micrometer bandspread tuning. Real construction throughout. Still under e. Together with matched dipole antenna all SW broadcasting bands. $160 or Gunn, 198 Hawken Drive, St Lucia, Bris- ld.

ECKS. New Garrard 240V 3¾ ips. $21 4lb) $1 N.S.W. Ten only. Freeman 318 George Street (opp. Wynyard).

HONES, Philips EV4304. Close packing 50 ohms. 12 for $120 or $14 each. Cost Box 122 Oakleigh, Vic.

FA.6000T World Wide, 6-band 11tran- AM/FM Portable receiver with mains As new $130. Frizell, Tele. Sydney 5.

and model supplies, Triang railways, ssi railways, Peco railways, Scalextric motor racing, Cox slot cars, Minic Motor- Dinky toys, Matchbox models, Meccano. or free price lists. Please indicate in- Free packing and postage on all orders. Productions, 15 Hamilton Street, Gis- Vic.

UCERS Piezoelectric Ceramic. We are offer transducer elements as applied to sounders, hydrophones, communication nt, ultrasonic apparatus, etc. in a wide of shapes, disc, rings, tubes, rectangles. cy ranges are from approximately to 3MHz and all articles come in a and polarised condition. Special low y stacks or mounted elements can be upon. These elements are a product company and data relating to individual ions can be supplied. All enquiries wel- Ultrasonic Industries Pty. Ltd., P.O. Bondi Junction, N.S.W.

EIVERS. Pye reporter MKIII, ex. taxi's. onversion frequency 80.7 megs trans- QV04/7 7 watts modulators, pair 6AQ5's vibrator supply 12 volt xtals limited $20 each plus freight. Taxifone Supplies, x 320 Ipswich, Qld.

Radio telephone, unused (STC) 148 to RF op. 25W, transistorised with mic. O.N.O. Apply 6/105 Annie Street, Tor- Brisbane, Qld.

K TV Analyst model 1076ES exc. condi- 200. Also B and K transistor analyst Write 94 Albion Road, Ashburton, Vic.

sweep marker generator. Palec valve ET4A Zenith modulated oscillator. test set type A7 capacity meter Uni- Superscope TUR-C5. Phone 759-5764, 33 Payten Ave., Punchbowl, N.S.W.

AKING SPECIALS. New and slightly led items at half price. ROLLS "Pent- portable stereogram, a real hi-fi unit, HOME STAR portable stereo players, nagers, $35 ea. CROWN Battery portable corders, capstan drive: CTR-5310 (3in $45. CTR-5400 (5in spools) $60. 00 (5in spools) $56. All items guaranteed . Vista Distributing Services, 78 Robert Wickham, N.S.W. 61-4908.

K transistor ignition kits, new but shop 12V only, fully guaranteed. To clear at ce. Negative earth $30, postive $39. Distributing Services, 78 Robert Street, n. N.S.W. 61-4908.

INJECTOR KIT. 5000cps—2MC. andy instrument indeed, 2 transistors. size. 29/6 ($2.95). 35/ wired and Post free. Prompt service. KITSETS BOX 176, P.O., DEE WHY, N.S.W.

YOUR OWN transistor radio for 99/6. 50 miles, no aerial needed, drives 9V. Kit complete, inc. speaker. Price $9.95). Wired and tested $11.55. KIT- UST. BOX 176, P.O. DEE WHY, N.S.W.

SALE. Receivers, amps., instruments, ents, etc. Send for details. KITSETS BOX 176, P.O., DEE WHY, N.S.W.

R BOOSTER AMPLIFIER. Covers —20MC. Improves sensitivity, selectivity /noise ratio. Stops fade. Power gain: Unit is connected in series with aerial Price 49/6 ($4.95). Wire and tested Post free, prompt service. KITSETS BOX 176, P.O., DEE WHY, N.S.W.

FOR SALE

MODEL Traction Engine. Castings with detail drawings. Bolton, 72 King Street, Sydney, 2001. Catalogue 80c.

RESISTOR SPECIAL. Miniature ½W. 5 per cent tol. Top grade. Will supply three only resistors of each preferred value between 10 ohms and 1 Meg. 57 different values, totalling 171 resistors. Full price $6.84 (4c each). Ideal for enthusiasts, servicemen, etc. Post free. KITSETS AUST., BOX 176, P.O. DEE WHY, N.S.W.

TRANSISTOR SHORT-WAVE RECEIVER. Four transistors. Covers 3.5-12MC. Good sensitivity. Speaker output. Ideal gift. Full price inc. postage: kitset form $13.95. Wired and tested $14.95. KITSETS AUST., BOX 176, P.O. DEE WHY, N.S.W.

TV Picture Tubes—14in to 24in. Trade only. New $12, rebuilt, 2-year warranty $12, 1-year $11. Bonded 23in new $26, rebuilt $24, seconds $16. All prices plus freight and dud or deposit on dud. 14in-21in 70 $6.90, $8, 21in 110 $8, 23in $10, 23in bonded dud deposit $9. Extra charge for scratches $2. Extra if air in dud $3 (bonded $6). Available at slightly higher price at 1120 Oxley Rd, Oxley, Brisbane. We buy duds. Sure Brite, 22a Victoria St., Lewisham, N.S.W. Phone 56-6363.

TAPE RECORDER Classic TR3, 2-track, 3-motor transcription deck $60. Neale, 49-5617 (Sydney), N.S.W.

STUDIO MICROPHONES. Pearl (Swedish) 8CK condenser mic, three patterns, flat 30-20KC, with power supply and cables, excellent condition, $120. RCA 44BX velocity mic, excellent condition, $60. B and O BM4 velocity mic, multi-imp. as new, $30. Two Sennheiser MD35 floor-stand mics, $24 each. Vista Recording Studios, 78 Robert St, Wickham, N.S.W. 61-4908.

RECORDING TAPE, new, boxed, guaranteed. 3in x 20ft 48c, 5in x 600ft $1.35, 7in x 1,200ft $1.50. Empty reels 5in, 30c, 7in 50c. Write for free list (inc. BASF). All Mail Order goods supplied. AIMO, Box 15, Footscray, Vic.

MULTIMETER repairs and sales. Fast service on all types of Multimeters, VTVM's, switchboard and panel meters. All popular brands of meters and radio and TV test equipment can be supplied. Trade-ins accepted. Please write for a catalogue. Metropolitan Meter Service, 1 Market St., Sydney 29-2268, N.S.W.

WANTED

CHRISTIAN BROADCASTING Association needs a CRO. Anybody like to donate one? CBA, 420 Lyons Road, Fivedock, N.S.W. Phone 83-7321.

BRAMCO Speaker transformer 6000 for Mullard 5-10. Dial Melb. 85-9827 or write 29 Salonika, Sorrento, Vic.

CRO Laboratory standard must have internal calibration, also B and K Analyst wanted. Ring N. Kofahl, Sydney, 69-7722.

WANTED. All surplus Radio and TV parts, valves, etc. CASH. Last, 847 New Canterbury Road, Hurlstone Park, N.S.W. 55-7151.

READER SERVICE

TAPE RECORDISTS! A.T.R.S. invites E.A. readers to attend a meeting at 7.30 p.m. on 11th July to be held in the "Star Room," Whitehall Hotel/Motel, 85-97 New South Head Road, Rushcutters Bay, Sydney. All welcome. Admission $1.50 per head. Smorgasbord supper provided. Trade demonstration. Further details, phone 43-6681 (Sydney) after hours.

PRE-RECORDED TAPE LIBRARY. Tape recorder owners. Join the Australian Tape Recording Society and have access to over 1500 top-quality tapes at 60c hire. Bi-monthly magazine, news-tapes, tape and equipment discounts. Send 40c S.A.E. to ATRS, Box 9, P.O., Crow's Nest, N.S.W.

TRANSFORMERS wound output or mains and specials to order. Paris Radio Electrics, 7a Burton St., Darlinghurst, N.S.W. 31-3273.

MICROGROOVE discs from your tapes. Also tape copying service. Highest quality discs at all speeds. Prompt service. Moderate charges country and interstate. Inquiries welcomed. Vitatone Recording Studios, Box 18, Post Office, Lane Cove, N.S.W. Phone (Sydney) 42-6154.

REPAIRS to receivers, transmitters, construction, testing. TV alignments. Xtal concs., specialised electronic equip. Eccleston Electronics, 146a Cotham Road, Kew, Vic. 80-3777.

TAPE to disc service. Take advantage of W. and G. Records professional experience when next needing a tape to disc service. W. and G. Record Processing Co., 185a Beckett Street, Melbourne. Tel. 329-7255.

READER SERVICE

ELECTRONIC ORGANS. Do not build yourself an organ without first consulting us. Send for initial information on the superb Schober (U.S.A.) build-it-yourself kits. No stamps required. The Electronic Organ Co., 124 Livingstone Avenue, Pymble, N.S.W. (Mail only.)

POSITIONS VACANT

ELECTRONIC TECHNICIANS.
Qualified Technicians are required for operation and maintenance of airborne electronic survey equipment—such as Doppler Radar Navigation Systems and Magnetic Detection Equipment. Desire to travel essential—both in Australia and overseas. Experience with aircraft equipment preferred, but not essential. Attractive field travel allowances paid.
GEOPHYSICAL RESOURCES DEVELOPMENT COMPANY,
Phone: Sydney 529-7336-7-8, N.S.W.

TELEVISION TECHNICIANS FOR NEW ZEALAND.—TISCO (N.Z.) LTD., New Zealand's largest TV Service Company, requires top-grade TV technicians for many of their 36 Branches throughout New Zealand.
Basic wages $A53.75 per week plus fringe benefits. All overtime after 5.30 p.m., Monday to Friday and all day Saturday paid at penalty rates. No Sunday work.
Air fares for technicians and dependants paid in full.
For further details, write in confidence, enclosing copy of references to
The General Manager,
TELEVISION INSTALLATION AND SERVICE CO. LTD.,
Private Bag,
Auckland, NEW ZEALAND.

POSITIONS WANTED

RADIO Mech., 39, married. HF-VHF some TV all electr. appliances incl. tape recorders, washing machines, etc. seeks pos., goes anywhere, accommodation appreciated. P.O. Box 12, Talbingo, N.S.W.

TECHNICIAN, really qualified, radio, television, tape recorders, etc. Age 35. Seeks position in country town, anywhere in Queensland except Brisbane. Blackshaw, 55 Lagoon Street, Goondiwindi.

CLASSIFIED ADVERTISERS

USE THIS FORM FOR YOUR NEXT ADVERTISEMENT TO APPEAR IN THE

ELECTRONICS Australia Classified Columns

To the Advertising Manager,
ELECTRONICS Australia,
Box 2728 G.P.O.
Sydney.

ENDORSEMENT ....

ADDRESS ....

.... STATE ....

• *Please insert the following advertisement in the* .... *issue*

• *I enclose P. Note/Cheque for $.... being full payment for ... lines at $0.60 per line.*

☐ FOR SALE ☐ WANTED ☐ READER SERVICE ☐ POSITION VACANT

Please write in block letters with ink or ball-point pen. Number of insertions ....

"ELECTRONICS Australia"

SPECIAL ORDER FORM

Guarantee yourself a complete set of issues for your library with no copies missing.

SUBSCRIPTION RATES

	PER YEAR	
Commonwealth, Fiji, N. Guinea	$4.10	£2. 1.0
United Kingdom & N. Zealand	$4.60	£A2. 6.0
British Dominions	$4.60	£A2. 6.0
Elsewhere	$5.60	£A2.16.0

POST THIS COUPON TO:—

The Circulation Manager, ELECTRONICS Australia, Box 2728, G.P.O., Sydney. Australia.

Name ....

Address ....

Enclosed is $ .... *for* ...... *years. Start with* ....

(Please use cheque, money order, etc. Do not enclose cash)

ADVERTISING INDEX

A. & R. Transformers Pty. Ltd. ..
A.C.E. Radio 152,
Adcola Products Pty. Ltd. .. .. ..
Aegis Manufacturing Co. Pty. Ltd. ..
Agfa-Gevaert Ltd. .. ..
Akai Electric Co. Ltd. .. ..
Amalgamated Wireless (A'sia) Ltd.
Amalgamated Wireless Valve Co. Pty Ltd. .. ..
Amplion (A'sia) Pty. Ltd. .. .. ..
Arrow Electronics Pty. Ltd. .. ..
Asdic Stereo Specialists .. .. ..
Astronic Imports Division .. .. ..
"Attention" .. ..
Audio Engineers Pty. Ltd., 107, 113,
Aust. General Electric Pty. Ltd. ..
Aust. Radio and TV College Pty. Ltd. .. .. B

Bright Star Radio .. ..
Broadway Electronics Pty. Ltd. .. ..
Broadway Electronics (Sales) Pty.
Broughton, Peter G. .. ..

Carter, P. Radio and TV Service ..
Chapman, Maurice and Co. Pty. Ltd. .. .. 60, 84, 100, Inside Fr
Classic Radio .. ..
Classified Advertisements .. .. ..
Claybridge Sound Systems .. .. ..
Comtel International (Vic.) Pty. Ltd.
Control Data Australia Pty Ltd. ..
Convoy International Pty. Ltd. .. ..
C.R.E. Institute .. ..

Danish Hi-Fi Pty. Ltd. .. ..
Decca .. ..
Deitch Bros. .. ..
Dept. of Supply .. ..
Dynacoustic Electronic Pty. Ltd. .. ..

Electronic Developments Pty. Ltd. ..
Encel Electronics Pty. Ltd., 19, 70,

Fairchild Australia Pty. Ltd. .. .. ..
Ferris Bros. Pty. Ltd. .. ..

General Accessories .. ..
Goldring Eng. (A'sia) Pty Ltd. .. ..
Goodmans Industries Ltd. .. .. ..
Gray, Simon Pty. Ltd. 12,
Grenville Publishing Co. 79, 85
G.R.D. Instruments Pty. Ltd., Inside B

Haco Distributing Agencies Pty. Ltd. .
Ham Radio Suppliers .. ..
H.B. Radio Sales .. ..
Hodges Sound Systems .. ..
Homecrafts Pty. Ltd. .. ..

International Correspondence Schools

Jacoby, Mitchell and Co. Pty. Ltd.
J.H. Reproducers Pty. Ltd. .. .. ..
Johnston, D. R. and Co. Pty. Ltd. .

Klapp Electronics Pty. Ltd. .. .. ..
Kuenzli, Ernest Pty. Ltd. .. .. ..

Lafayette Electronics Division .. ..
Letraset Australia Pty. Ltd. .. .. ..
Levinson, H. Pty. Ltd. .. ..

Magnetic Sound Industries .. .. ..
Magrath, J. H. and Co. Pty. Ltd. .
Manufacturers Spec. Prod. Pty. Ltd. 3
Marconi School of Wireless .. .. ..
Mastersound Sales Pty. Ltd. .. .. ..
Matson Automotive Ind. Pty. Ltd. .
McLellan, Wm. J. and Co. Pty. Ltd
Modern Science Supplies .. .. ..
Mullard-Australia Pty. Ltd. .. .. ..

National Radio Supplies .. ..

O'Rourke Industries .. ..

Paton Electrical Pty. Ltd. .. .. ..
Philips Electrical Pty. Ltd. .. .. ..
Photronic .. ..
Precision Windings .. ..
Pye Pty. Ltd. .. ..

Radio Despatch Service .. ..
Radio House Pty. Ltd. .. ..
Radio Parts .. ..
R.C.S. Radio Pty. Ltd. .. ..
Recorded Music Salon .. ..
Rosicrucians (Amorc) .. ..
Rowe, H. and Co. Pty. Ltd. .. .. ..

Sansui Electric Co Ltd. .. ..
SCEL Pty. Ltd. .. ..
Selectronic Components .. .. ..
Shalley, Peter Electronics Pty. Ltd. .
Solartron Electronic Group Ltd. .. ..
Stott's Tech. Correspondence College
Sure Brite Picture Tubes .. .. ..

Technical Book and Magazine Co. ..
Technical Training Int. Pty. Ltd. .. ..
Tel-Leigh Tubes .. ..
Telex (Aust.) Pty. Ltd. .. ..
Thomas Electronics of Aust. Pty. Ltd
"Thought Power" .. ..
Trio Corporation .. ..
Turnbull, Bill .. ..

United Radio Distributors Pty. Ltd. .
United Trade Sales Pty. Ltd. .. .. .
University Graham Inst. Pty. Ltd. .

Warburton Franki Ltd. .. ..
Watkin Wynne Pty. Ltd. .. ..
Weston Electronics Pty. Ltd. .. .. ..
Willis, S.E. Trading Co. .. ..
Willis, William and Co. Pty. Ltd .
Wireless Institute of Australia (N.S.W
Wireless Institute of Aust. (Vic.) .
Wonder Wool Pty. Ltd. .. ..

Zephyr Products Pty. Ltd. 30

Read what the experts say -

self-
here
with
have
e re-
sepa-
aker
most
ality
class
e in-

Belt-drive turntables are considered by many experts superior to those with rubber wheel drive. The latter can be prone to speed fluctuations, caused by flat spots developing on the rubber drive wheel.

And it is essential that the drive motor be noise-free, accurate and steady.

A pick-up arm must be well balanced and the cartridge and stylus

Melbourne "AGE", Sound Supplement, 24th April, 1967.

R PERFECTION in PERFORMANCE

(free from rumble, wow or flutter)

aintained over years of trouble-free service

ing matches the

NEW LABCRAFT - SRT TURNTABLES

her improved, with NEW features that include :-

active matt black baseplate with chrome ting screws. Large diameter motor spindle 3 speed drive. Improved intermediate wheel nbly. Sag-proof motor suspension. Machined cast aluminium ring on platter. And, on the model, black easy clean mat on chrome turn- e, new chrome-plated speed change with rged knurled speed adjustment knob.

orating these advanced design features to en- istained perfection in performance over long s of operation:-

ial flexible rim-belt drive from truly vi- ion-free patented motor suspension which isolates all vibration from baseplate - gives perfect performance completely free of rumble, wow and flutter.

* Asynchronous motor (not tied to mains frequency) with special governor making motor speed in- dependent of mains voltage and frequency with variable speed adjustment of plus or minus 10%.
* Drive spindle ground to extremely fine toler- ances - nylon and bronze bearings are self- lubricating, virtually service free.

Attractive Danish design polished wood bases, as illustrated, available in Ash, Teak or Palisander, from $9.35.

abcraft – *Australia's most popular true hi–fi turntables!*

605 illustrated with B & O ST/L arm & SP2 Magnetic Cartridge, Retail $34.52

605L & 655 illustrated with All Balance Arm, Retail $24.27. Takes B & O SP1 Cartridge - $19.44; SP6 (15°) - $24.32, or SP8 (Elliptical) - $50.

)5 Model
nat, Retail $53.61

The 605L Model
12" mat, Retail $61.58

The 655 De Luxe Model
12" mat, Retail $69.36

smoked-plastic dust covers also available, $12.22

leading retailers throughout Australia including:-

V.	United Radio Dist., Shop 32, Ash St., Sydney	VIC.	Danish Hi-Fi Pty. Ltd., 66 Mayston St., Camberwell
	Bardsley Imp. Tdg., Co., 166D Glebe Rd., Glebe	Q'LD.	(Distributors) Brisbane Agencies, 76 Wickham St., Fortitude Valley
RRA	J.B.Young Ltd., Kingston, Canberra		
	MACK'S ELECTRONICS, 199 Rundle St., Adelaide		
	Truscott Electronics, 62 Hindmarsh Sq., Adelaide		

STRALIAN AGENTS
.R.D
MENTS PTY. LTD.

6 Railway Walk, Camberwell, Victoria.
Telephone: 82 1256.

G.R.D. INSTRUMENTS PTY. LTD.
6 RAILWAY WALK, CAMBERWELL, VIC.
Please post Labcraft Literature to:-
NAME ....
ADDRESS ....
...............STATE GRD9

Printed and published by Sungravure Pty. Limited, of Jones Street, Broadway, at Morley Avenue, Rosebery.

YOU CAN EARN BIG MONE[Y] IN TELEVISIO[N]

ASK YOURSELF THESE 3 QUESTIONS!

1. Am I in a dead-end job? 2. Could I **earn** more by **learning** more? 3. Could I use my spare time to get ahead?

If the the answer is yes, there is room for **you** in radio/television!

NOW IS THE TIME TO TRAIN!

Does **your** job offer good prospects — real security? Does it hold your interest? If not, now is the time to do something about it. Television is expanding daily. It's the most exciting subject you can study. The sky's the limit for the **trained man** . . . **but only** the trained man. Radio and television technicians are in huge demand. Train for success now, in Australia's fastest-growing industry! **Join the ranks of skilled men** . . . the Australian Radio and Television College can train you for a bright future with unlimited prospects. Send for the free booklet "Careers in Radio and Television" . . . and find out how A.R.T.C. can bring you success—in your own business or as well-paid technical staff!

A.R.T.C. CAN TRAIN YOU AS IT HAS THOUSANDS OF OTHERS

For over 30 years A.R.T.C. has successfully trained thousands of progressive Australians who realised how much the training could mean to them. Now they're making big money in radio and television. Training can bring **you** success, too.

FOR A FEW PENCE PER DAY YOU CAN STUDY THE A.R.T.C. WAY

. . . in your *spare* time, you can equip yourself for a rewarding career in radio/television. *The future belongs to the trained. The A.R.T.C. "Service Engineering Course" teaches you from the ground up . . . step by step . . . at your own pace.* Remember, opportunity is always knocking for the *trained* man!

PRACTICAL UP-TO-DATE LESSONS

At the work benches and lecture halls of A.R.T.C. — or in your own home by correspondence — you can learn every necessary aspect of radio and television, every application of fundamental principles. The Course gives you both basic and advanced instruction in all phases.

No previous experience or high educational standard required . . . only enthusiasm and normal intelligence. A.R.T.C. will give you all the instruction you need. Each lesson is made easy to understand by numerous illustrations and diagrams. The Course adapts itself to **your** requirements, your speed. It's up to you! Instruction is individual and intensely practical.

THOUSANDS OF SUCCESSFUL STU[DENTS] HAVE PROVED THIS

Make spare-time money!

Make your spare time earn [...] for you while training at hom[e]

Many students make extra [...] after only a few weeks' tuitio[n] the modern A.R.T.C. worksho[p] more convenient.

GET INTO ONE OF TH[E] PROFITABLE CARE[ERS] IN RADIO/TELEVIS[ION]

GET INTO ONE OF TH[E] PROFITABLE CAREE[RS]

There is a career for you in the many phases of radio/televisi[on] cluding manufacture, servicin[g] search, sales, executive positi[ons] broadcasting and television, forces.

A.R.T.C. can help you gain these sought-after careers. Rem[ember] it's the trained man who wins, time!

MAIL COUPON NO[W]

Safeguard **your** future! You are invited in the coupon below. A.R.T.C. will [...] by return their big free and post-free "Careers in Radio and Television." citing book shows you definite steps take towards a big future—how you [...] ceed in life and find satisfaction in worthwhile job well.

AUSTRALIAN RADIO AND TELEVISION COLLEGE PTY. LTD.

E. S. & A. BANK BUILDING,

Cnr. Broadway and City Road, Sydney.
(Opp. Grace Bros.) Phone 211-4244 (3 lines.)

AUSTRALIAN RADIO & TELEVIS[ION] COLLEGE PTY. LTD.,

206 Broadway, Sydney, N.S.W.

Dear Sir,

Please send me, without obligation, y[our] booklet "Careers in Radio and Television[."]

NAME ....

ADDRESS ....

....

Printed by Sungravure Pty. Limited, of Jones Street, Broadway, at Morley Avenue, Rosebery